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NATIONAL DAM INSPECTION PROGRAM, KEHLY RUN DAM NUMBER 3 (NDS ID--ETC(U)
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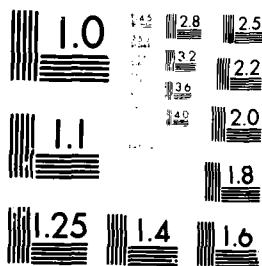
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SUSQUEHANNA RIVER BASIN
KEHLY RUN, SCHUYLKILL COUNTY

PENNSYLVANIA

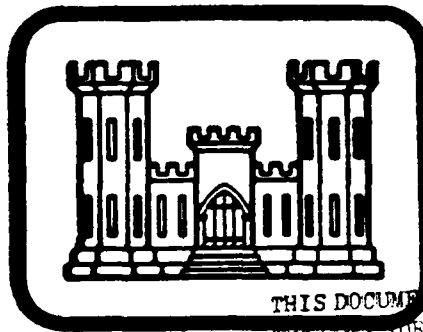
KEHLY RUN DAM NO. 3

NDS ID NO. PA-657

DER ID NO. 54-17

SHENANDOAH MUNICIPAL AUTHORITY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

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SUSQUEHANNA RIVER BASIN
KEHLY RUN, SCHUYLKILL COUNTY

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PENNSYLVANIA

National Dam Inspection Program

KEHLY RUN DAM NO. 3

(NDS ID ^{Number} PA-657)

DER ID ^{Number} 54-17)

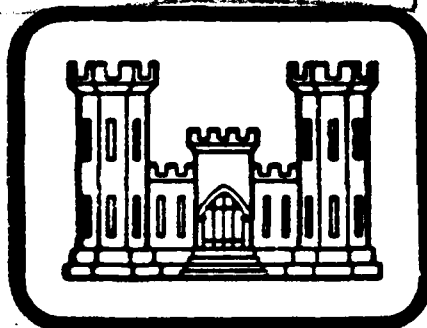
Susquehanna River Basin, Kehly Run, Schuylkill County,

SHENANDOAH MUNICIPAL AUTHORITY

Pennsylvania.

PHASE I INSPECTION REPORT, NATIONAL DAM INSPECTION PROGRAM

⑩ R. Jeffrey Kimball



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⑪ MARCH 1980

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Kehly Run Dam No. 3
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Schuylkill
STREAM	Kehly Run
DATE OF INSPECTION	November 7 and 16, 1979

ASSESSMENT

The assessment of Kehly Run Dam No. 3 is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance.

Kehly Run Dam No. 3 appears to be in fair condition. Several areas of "possible past instability" are apparent on the downstream slope. In addition, extensive seepage areas have been reported in the past but may be obscured by the tailwater. Maintenance of the dam and operating facilities is considered poor.

Kehly Run Dam No. 3 is a high hazard-small size dam. The spillway design flood is the PMF (probable maximum flood). The spillway and reservoir are capable of controlling approximately 17% of the PMF without overtopping the embankment. Based on criteria established by the Corps of Engineers the spillway is termed inadequate, but not seriously inadequate.

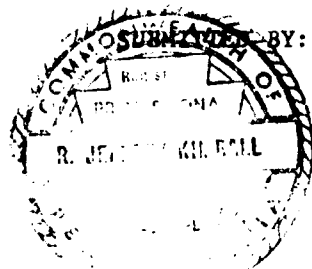
The following recommendations and remedial measures should be instituted immediately.

1. A detailed hydrologic and hydraulic study should be conducted by a professional engineer knowledgeable in dam design to develop plans to increase spillway capacity. The exit channel and spillway wingwall should be evaluated to determine whether improvements are required. Many of the reservoirs in the Kehly Run system do not control the PMF, thus all spillways in the system should be studied and upgraded because of the severe consequence of failure of reservoirs in series and the location of the Borough of Shenandoah downstream.

2. The trees and large vegetation on embankment slopes and in the spillway should be cleared at the direction of a professional engineer knowledgeable in the design and construction of dams.

3. Some means of positive closure of the drainline should be developed in case of emergencies.

4. Exercise and lubricate all valves on a regular basis.
5. A detailed study should be conducted by a registered professional engineer knowledgeable in earth dams to evaluate the seepage, possible slope instability and source of discharge from the swimming pool on the stability of the structure.
6. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.
7. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.
8. A subsidence investigation should be conducted by the owner or his engineer to determine the effects of past and present mining beneath the reservoir.



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

March 18, 1980
Date

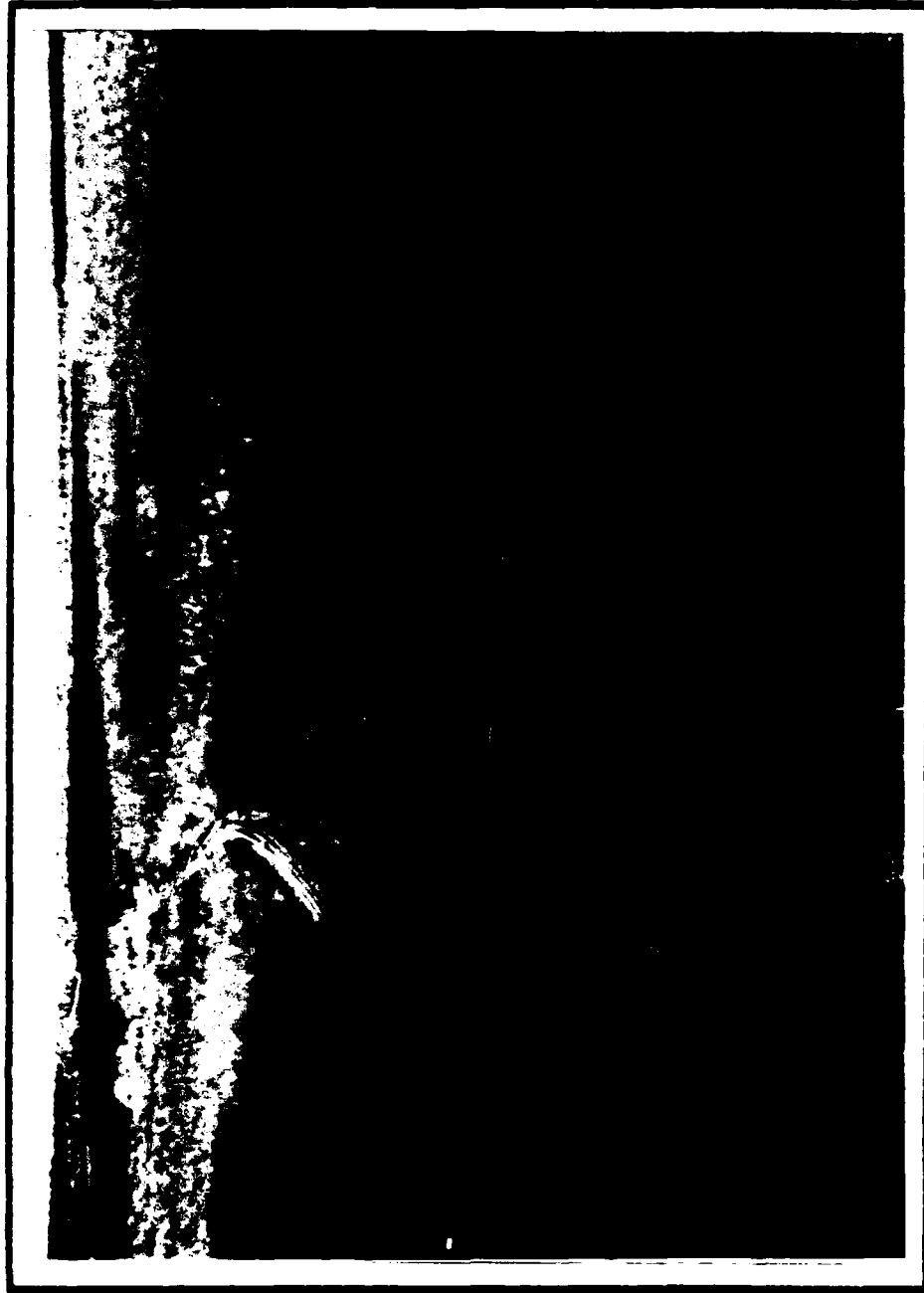
R. Jeffrey Kimball
R. Jeffrey Kimball, P.E.

APPROVED BY:

25 March 1980
Date

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

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Overview of Kehly Run Dam No. 3. Downstream of Kehly Run Dam No. 3 is the swimming pool (formerly Kehly Run Dam No. 2). Note upstream dams (Kehly Run Dam No.'s 4, 5, and 6) in upper left corner.

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PHASE I
NATIONAL DAM INSPECTION PROGRAM
KEHLY RUN DAM NO. 3
NDI. I.D. NO. PA 657
DER I.D. NO. 54-17

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Kehly Run Dam No. 3 is an earth and rockfill dam 442 feet long and approximately 33 feet high. The upstream slope is 1H:1V and covered with hand placed riprap. The downstream slope is 1.5H:1V and covered with rock rubble. The reservoir drain consists of a 10" cast iron pipe under the embankment.

The spillway is an open cut channel located on the left abutment. A stone masonry wall forms the junction between the spillway and the embankment. The left abutment hillside forms the left portion of the spillway. The spillway crest has a total length of 35 feet and has an irregular bottom. The spillway discharge channel winds along the left abutment and is confined by a stone rubble dike.

Immediately downstream of Kehly Run Dam No. 3 is a swimming pool which forms tailwater on the dam. This swimming pool is formerly Kehly Run Dam No. 2. Upstream of Kehly Run Dam No. 3 are three reservoirs (Kehly Run Dams No. 4, 5, 6).

b. Location. The dam is located on Kehly Run, one-half mile north of Shenandoah, Schuylkill County, Pennsylvania. Kehly Run Dam No. 3 can be located on the Shenandoah, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Kehly Run Dam No. 3 is a small size structure (33 feet high, 40 acre-feet).

d. Hazard Classification. Kehly Run Dam No. 3 is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail (See Section 3.1e).

e. Ownership. Kehly Run Dam No. 3 is owned by The Shenandoah Municipal Authority. Correspondence should be addressed to:

Shenandoah Municipal Authority
26 West Lloyd Street
Shenandoah, PA 17976
Attention: Charles Dallazia, Manager
717-462-1904

f. Purpose of Dam. Kehly Run Dam No. 3 is used for water supply.

g. Design and Construction History. The dam was built in approximately 1872. No information is available on the design or construction of the original dam. No drawings are available on the dam. The spillway was originally located in the center portion of the embankment but was moved to the left abutment prior to 1920.

h. Normal Operating Procedure. The reservoir is maintained at the spillway crest elevation 1495.0. Excess inflow is discharged over the spillway crest. Water is drawn off Kehly Run Dam No. 3 through the outlet works into the water system. It is believed that the outlet works pipe is used as the reservoir drain.

1.3 Pertinent Data.

a. Drainage Area. 1.01 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Unknown
Spillway capacity at top of dam	490
Reservoir drain	Unknown

c. Elevation (U.S.G.S. Datum) (feet). - Field survey based on pool elevation 1495 shown on USGS 7.5 minute quadrangle.

Top of dam - low point	1497.6
Top of dam - design height	Unknown
Maximum pool - PMF	1498.9
Full flood control pool	Not applicable
Normal pool	1495.0
Spillway crest	1495.0

Streambed at centerline of dam	1465.2
Tailwater on day of inspection	1464.1
Toe of dam	1465.2

d. Reservoir (feet).

Length of maximum pool (PMF)	600
Length of normal pool	400

e. Storage (acre-feet).

Normal pool	33
Top of dam	40

f. Reservoir Surface (acres).

Top of dam	2.7
Normal pool	2.4
Spillway crest	2.4

g. Dam.

Type	Earth and rockfill
Length	442'
Height	33'
Top width	16'
Side slopes - upstream	1H:1V
- downstream	1.5H:1V
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown

h. Reservoir Drain.

Type	10" CIP
Length	Approximately 110'
Closure	Valve at toe
Access	None
Regulating facilities	Valve at toe

i. Spillway.

Type	Open cut channel
Weir Length	35'
Crest elevation	1495'
Upstream channel	Unrestricted
Downstream channel	Narrow open channel

SECTION 2 ENGINEERING DATA

2.1 Design. Review of information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources revealed that inspection reports, permits, photographs and correspondence were available for review. No design reports or original design drawings or construction data was available. The data that was available was reviewed for this study.

2.2 Construction. No data is available on construction of the dam.

2.3 Operation. No operating records are maintained.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER, Bureau of Dams and Waterway Management and the owner. The manager of the Municipal Authority was interviewed to obtain data on operation and maintenance of the dam. The owner did not provide any information on past deep mining activities in the area of the dam and reservoir.

b. Adequacy. A detailed analysis cannot be made because of the lack of detailed design information or drawings. This Phase I Report is based upon available data, visual inspection, and a hydrologic and hydraulic analysis.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Kehly Run Dam No. 3 was conducted by personnel of L. Robert Kimball and Associates on November 7 and 16, 1979. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in fair condition. From a brief survey conducted during the inspection, it was noted that a low spot was present adjacent to the spillway. The upstream slope was measured to be 1H:1V and covered with hand placed masonry. The downstream slope was measured to be 1.5H:1V and covered with stone rubble. The crest width is 16 feet. The upstream slope was covered with small trees and brush and the downstream slope was covered with larger trees and brush. The downstream slope showed two areas (one located near the center of the embankment, the other located near the left abutment) that have either had new material added or showed signs of possible slope movement. A small amount of seepage was present along the left abutment. This seepage was partially obscured by the presence of large boulders dumped on this abutment. The swimming pool located at the toe of dam (formerly a dam named Kehly Run Dam No. 2) may have partially obscured this seepage and obscured viewing the toe of dam.

c. Appurtenant Structures. The open cut spillway is located on the left abutment. The junction of the spillway and the embankment is formed by a masonry wall. This masonry wall is in need of repair. The weir has an irregular crest caused by the severe deterioration of the concrete. The weir is 19 feet long at elevation 1495.0. The weir gains an additional 16 feet of width (total 35 feet) by gently sloping upward to meet the natural hillside. The spillway exit channel is narrow and very irregular. The channel follows the left abutment hillside and is formed by a stone rubble dike (See photographs, Appendix C).

The 10" cast iron pipe outlet works was not observed during the inspection. The valve to control flow through the outlet works is below the toe of dam. No upstream shutoff is provided.

d. Reservoir Area. The watershed is covered mostly with woodland. The reservoir slopes are moderately steep but are not susceptible to landslides which would affect the storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. The channel downstream of Kehly Run Dam No. 3 is narrow for approximately 1800 feet until it fans out into the Borough of Shenandoah.

3.2 Evaluation. In general, the embankment and appurtenant structures appear to be in fair condition but poorly maintained.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is maintained at the spillway crest elevation 1495.0. The valve in the outlet works remains open so that water enters the water system. The excess inflow discharges over the spillway crest. The valve is reportedly operated on a regular basis.

4.2 Maintenance of the Dam. No planned maintenance schedule exists. Maintenance of the dam is performed by the Municipal Authority staff. Maintenance of the dam is considered poor.

4.3 Maintenance of Operating Facilities. Maintenance of the spillway and outlet works is considered poor. The valve on the outlet works is reportedly operated regularly.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. Maintenance of the dam and operating facilities is considered poor. There is no system in effect to warn downstream residents of large spillway discharges or failure of the dam.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No calculations or design data pertaining to hydrology were available.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The spillway has reportedly functioned adequately in the past.

c. Visual Observations. The spillway appeared to be in poor condition. The spillway crest is badly deteriorated, sedimentation and debris has destroyed the original overflow channel. The discharge channel is narrow and flow is partially restricted by occasional large boulders.

A low spot was noted on the dam embankment adjacent to the right spillway wingwall. This area could easily be filled to increase the top of dam elevation.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. The pool elevation in the reservoir prior to the storm is 1495 feet.

2. For the overtopping analysis a top of dam elevation of 1497.6 feet (low spot) was assumed for the entire length of the crest of 442 feet. Field survey measurements taken during the inspection indicate that the top of dam varies from 1497.6 feet to 1498.6 feet.

3. For the dam breach analysis it was assumed that dam failure would begin when the water level in the reservoir reached elevation 1497.9 or 0.30 feet over the top of the dam.

4. The flood was routed through all upstream reservoirs.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	2764 cfs
Spillway capacity	446 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for this dam is the PMF. The SDF is based on the hazard and size classification of the dam. Based on the following definition provided by the Corps of Engineers, the spillway is rated as inadequate as a result of our hydrologic analysis.

Inadequate - All high hazard dams which do not pass the SDF (PMF), but where failure due to overtopping does not significantly increase the hazard potential for loss of life downstream.

The spillway and reservoir are capable of controlling approximately 17% of the PMF without overtopping the dam (based on low spot).

5.4 Summary of Dam Breach Analysis. As the subject dam cannot satisfactorily pass 50% of the PMF (based on our analyses) it was necessary to perform a breach analysis and downstream routing of the flood wave. This analyses determines the degree of increased flooding due to dam failure.

The water level in the reservoir at the time of dam failure was assumed to be at 1497.9 feet (0.30 feet over the top of dam low spot) based on the evaluating engineers judgement. The 30% PMF was routed through the reservoir and downstream.

The flood wave was routed downstream with and without embankment failure conditions considered. The flood was not routed through the swimming pool because of its small size.

Results of the Dam Breach analysis indicate that downstream flooding is not significantly increased. Since flooding downstream is not significantly increased due to dam failure, the spillway is not considered seriously inadequate. Therefore, this spillway is rated as "inadequate".

Note: Future development within the watershed, at the dam, or downstream may change the characteristics and assumptions made for this study and different results are likely. Future development downstream may also greatly increase the potential for loss of life due to failure of the structure.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Two locations on the downstream embankment slope showed possible signs of instability. These two areas appear as if some of the rock rubble has recently moved downslope. These areas are not vegetated. These areas are located approximately 160 feet from the right abutment and adjacent to the spillway.

A very small amount of seepage was present approximately 150 feet to the right of the spillway at the toe of dam. It is reported in the correspondence that Kehly Run Dam No. 2 (swimming pool) was constructed to collect seepage. However, because of the swimming pool and the presence of large rock boulders on the left abutment this seepage is obscured. The swimming pool at the toe of dam may be obscuring the presence of a large quantity of seepage. The outflow from the swimming pool is several hundred gallons per minute. Past history indicates a large amount of seepage near the toe of dam.

b. Design and Construction Data. No stability analyses are on record for this dam. No data on the design or construction is available.

c. Operating Records. No operating records are maintained.

d. Post Construction Changes. No post construction changes are known other than reconstruction of the spillway on the left abutment and construction of Kehly Run Dam No. 2, downstream of Kehly Run Dam No. 3.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected loading.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in fair condition. There is evidence that slow movement is taking place or has recently taken place on portions of the downstream slope. A small amount of seepage was in evidence during the inspection. In addition, past inspections report a considerable amount of seepage at the toe of dam prior to construction of Kehly Run Dam No. 2. The tailwater may be obscuring a high seepage rate. The visual observations, review of available information, hydrologic and hydraulic calculations and past operations and performance indicate that Kehly Run Dam No. 3's spillway is inadequate but not seriously inadequate. The spillway is capable of controlling 17% of the PMF without overtopping the earth embankment. No adequate stability analysis has been performed for this structure. The long term affect of the seepage is unknown.

b. Adequacy of Information. Detailed analyses of the structure cannot be made because of the lack of any design or construction data. This Phase I Report is based upon visual observations, review of available data, hydrologic and hydraulic calculations and past operations and performance.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. To complete some of the recommendations/remedial measures outlined below, additional investigations are required.

7.2 Recommendations/Remedial Measures.

1. A detailed hydrologic and hydraulic study should be conducted by a professional engineer knowledgeable in dam design to develop plans to increase spillway capacity. The exit channel and spillway wingwall should be evaluated to determine whether improvements are required. Many of the reservoirs in the Kehly Run system do not control the PMF, thus all spillways in the system should be studied and upgraded because of the severe consequence of failure of reservoirs in series and the location of the Borough of Shenandoah downstream.

2. The trees and large vegetation on embankment slopes and in the spillway should be cleared at the direction of a professional engineer knowledgeable in the design and construction of dams.

3. Some means of positive closure of the drainline should be developed in case of emergencies.

4. Exercise and lubricate all valves on a regular basis.

5. A detailed study should be conducted by a registered professional engineer knowledgeable in earth dams to evaluate the seepage, possible slope instability and source of discharge from the swimming pool on the stability of the structure.

6. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

7. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

8. A subsidence investigation should be conducted by the owner or his engineer to determine the effects of past and present mining beneath the reservoir.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Kehly Run Dam No. 3 COUNTY Schuylkill STATE Pennsylvania ID# PA 657
TYPE OF DAM Earth and rockfill HAZARD CATEGORY High
DATE(s) INSPECTION Nov. 7 and 16, 1979 WEATHER Cloudy, warm TEMPERATURE 50°

POOL ELEVATION AT TIME OF INSPECTION 1495.0 M.S.L. TAILWATER AT TIME OF INSPECTION 1464.2 M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

James T. Hockensmith _____ RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted in embankment.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Two areas, 150 feet from right abutment, and adjacent to spillway, appear to have had recent slope movement and recently placed material added.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment appears to be good. Vertical, low spot on the spillway.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Small trees and brush on upstream slope. Trees and brush on downstream slope.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be good. Masonry wall at embankment -spillway contact in need of repair.	
ANY NOTICEABLE SEEPAGE	Minor amount of seepage noted at junction of left abutment and toe of dam. However, considerable amount of seepage may be present beneath the tail- water.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet works unobserved during inspection.	
INTAKE STRUCTURE	Unobserved during inspection.	
OUTLET STRUCTURE	None.	
OUTLET CHANNEL	None.	
EMERGENCY GATE	Valve beyond toe of dam. Not operated during inspection.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Very irregular weir surface. Right wall of spillway shows considerable deterioration.	
APPROACH CHANNEL	Lake.	
DISCHARGE CHANNEL	Stone rubble dike forms the discharge channel.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

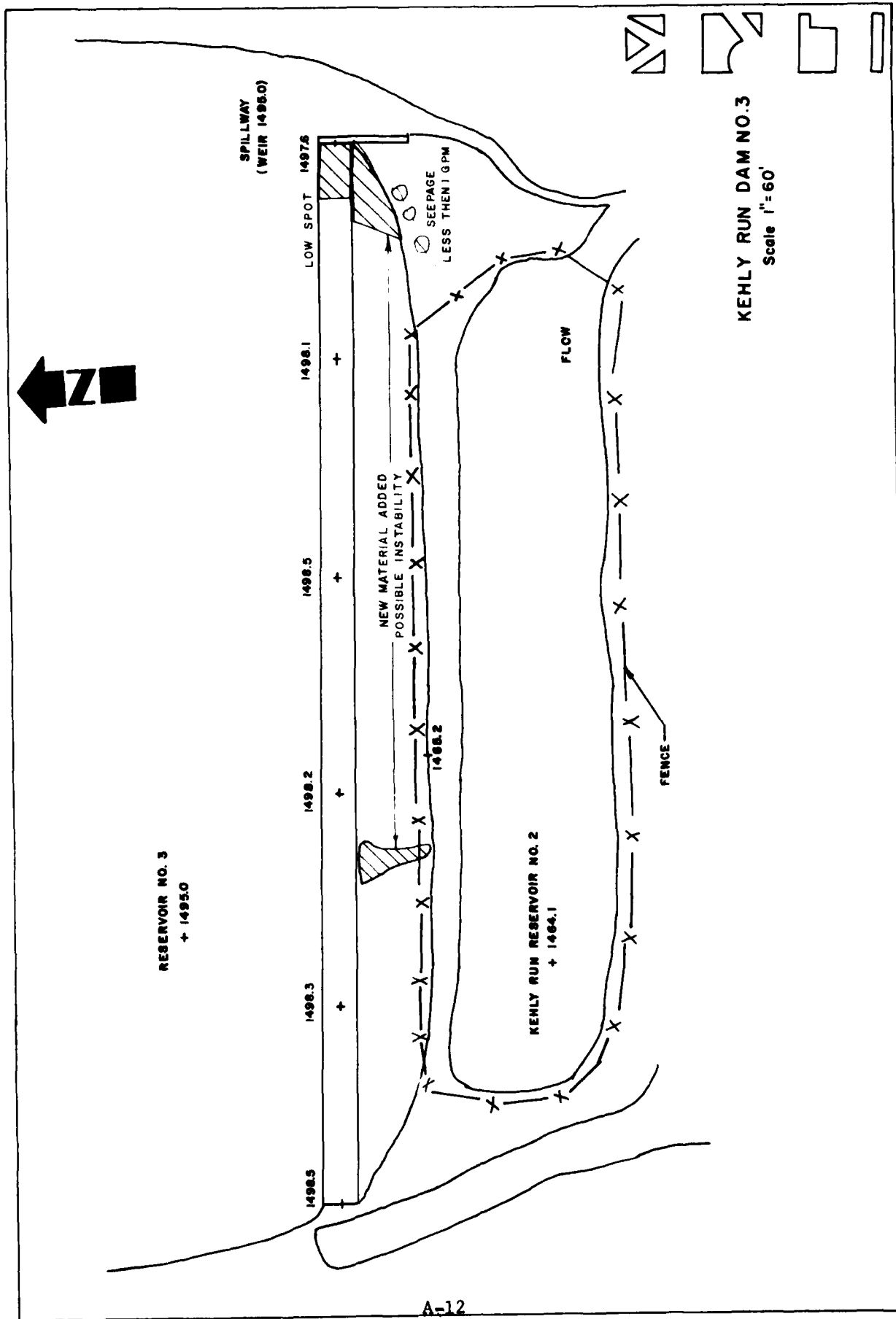
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Narrow confined channel.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 400 homes - 1600 people.	

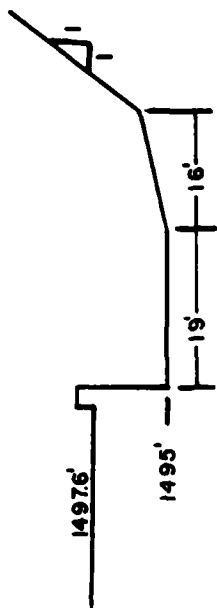
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Steep but appear to be stable.	
SEDIMENTATION	Does not appear to be excessive because of upstream reservoirs.	

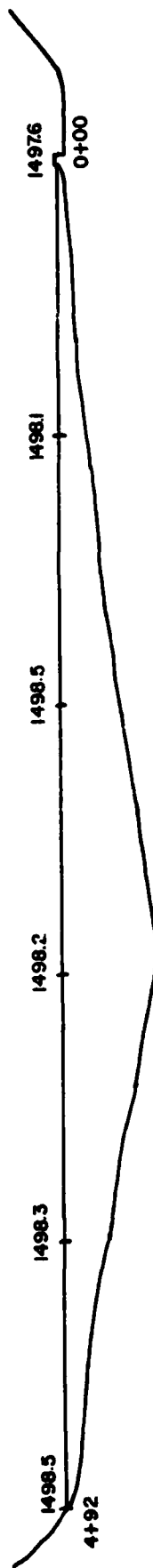
INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	





SPILLWAY PROFILE
(Not to Scale)



**PROFILE
LOOKING UPSTREAM**



KEHLY RUN DAM NO.3
Scale 1"=60'

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION,
PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Kehly Run Dam No. 3

ID# PA 657

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	USGS quadrangle.
CONSTRUCTION HISTORY	None.
TYPICAL SECTIONS OF DAM	None.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	None. None. None. None. None.

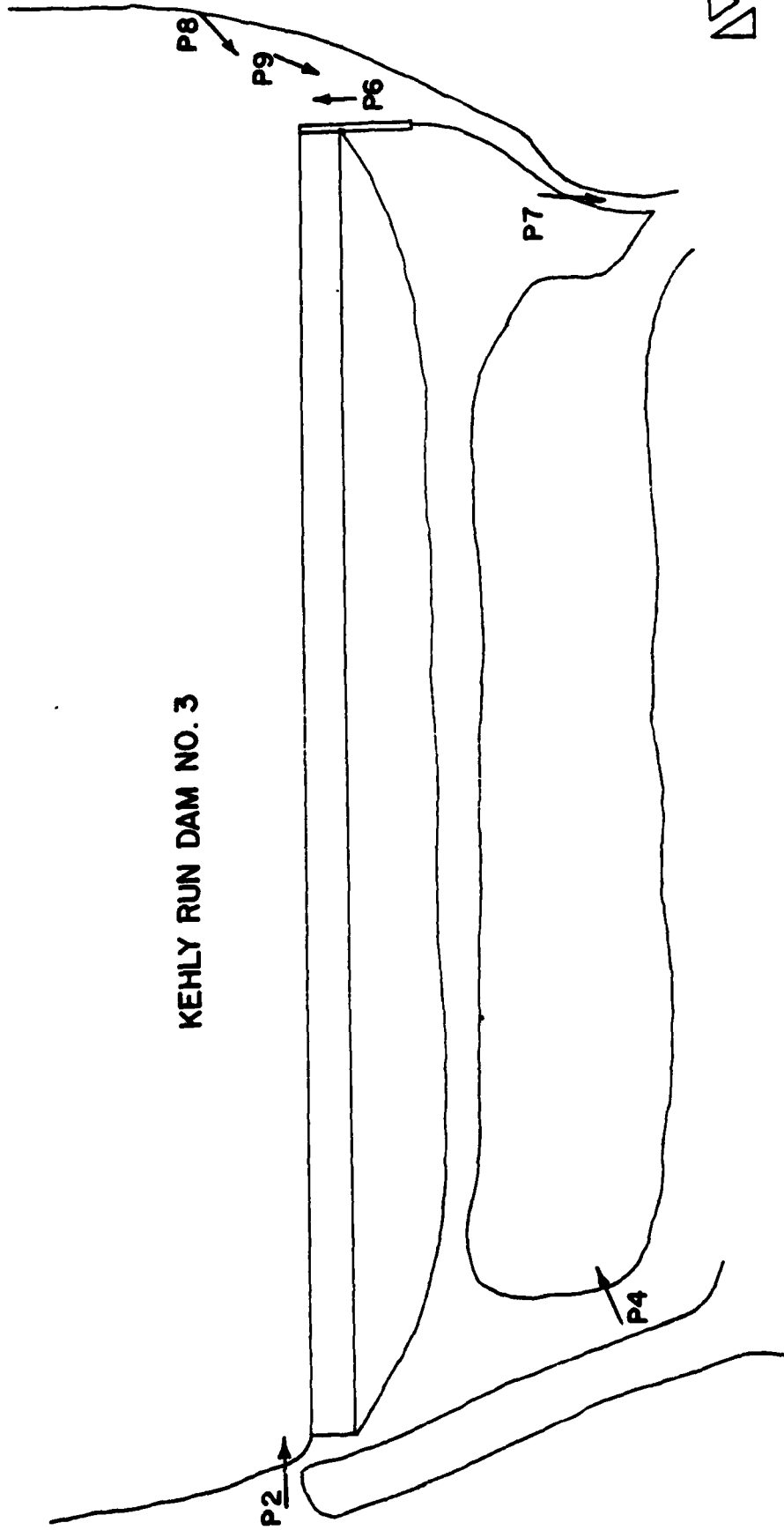
ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Unknown.
POST-CONSTRUCTION SURVEYS OF DAM	Unknown.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Unknown.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS

KEHLY RUN DAM NO. 3



KEHLY RUN DAM NO. 3
PHOTO INDEX

P - INDICATES PHOTO LOCATION

KEHLY RUN DAM NO. 3

Photograph Descriptions

Sheet 1. Front

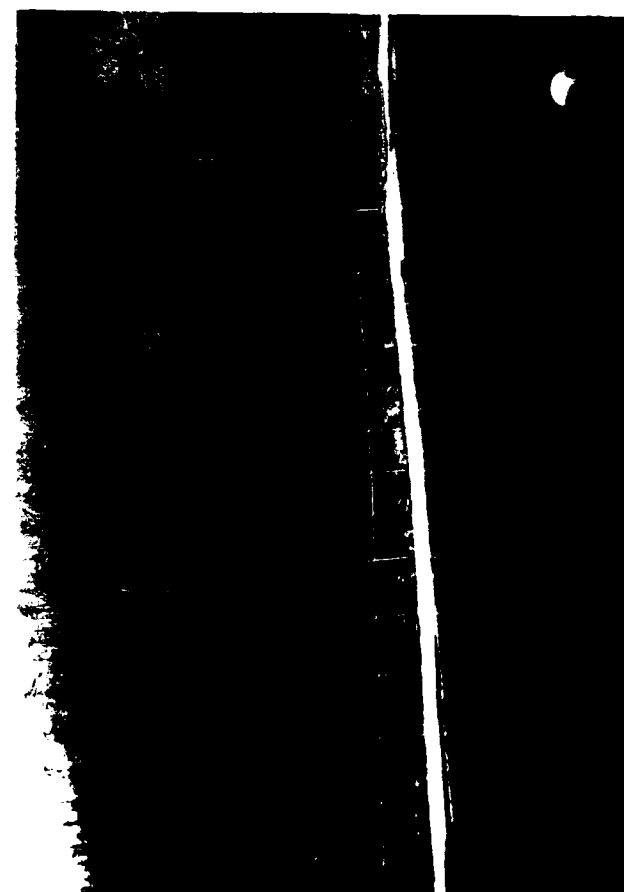
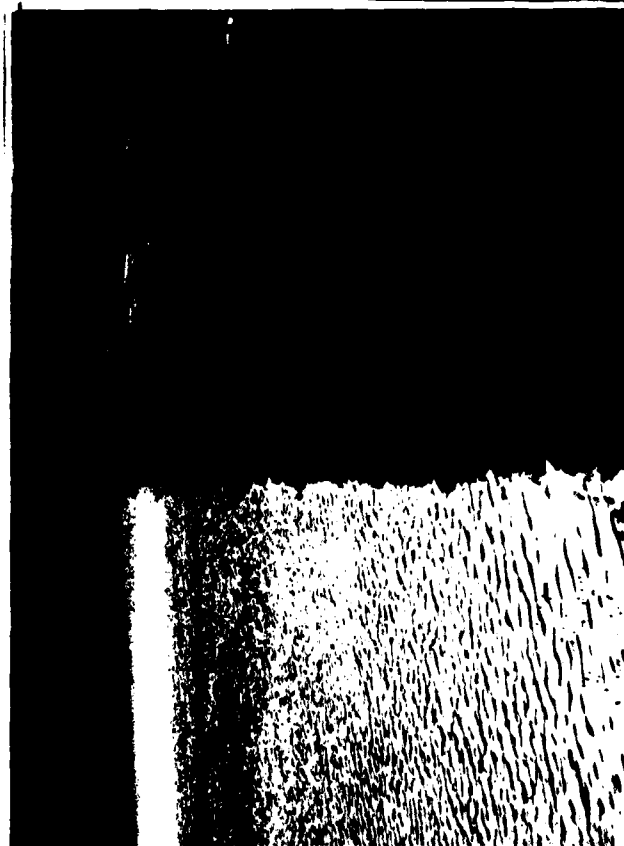
- (1) Upper left - Spillway on Kehly Run Dam No. 4.
- (2) Upper right - Upstream slope of Kehly Run Dam No. 3.
- (3) Lower left - View of crest of Kehly Run Dam No. 4
(upstream dam). In background is
downstream slope of Kehly Run Dam No. 5.
- (4) Lower right - Downstream slope of Kehly Run Dam No. 3.

Sheet 1. Back

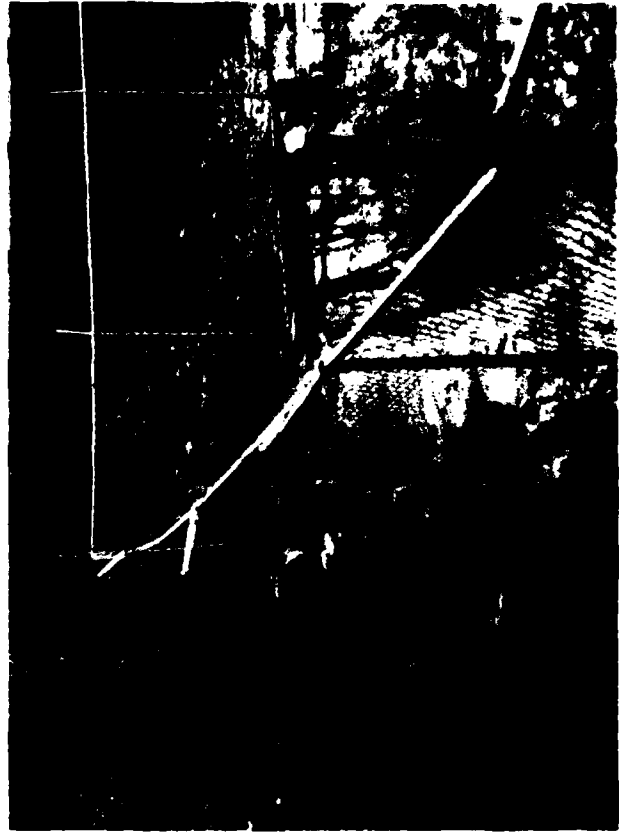
- (5) Upper right - Downstream exposure (Shenandoah Borough).
Coal refuse embankment in foreground.

Sheet 2. Front

- (6) Upper left - Spillway weir.
- (7) Upper right - Spillway discharge channel along swimming
pool.
- (8) Lower left - Upstream slope and spillway entrance.
- (9) Lower right - Spillway discharge channel.







APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topographic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimeted from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS DATA BASE

NAME OF DAM: Kehly Run Dam No. 3

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (1.005) = 22.3"

STATION	1	2	3	4
Station Description	Kehly No. 6	Kehly No. 5	Kehly No. 4	Kehly No. 3
Drainage Area (square miles)	0.29	0.11	0.04	0.57
Cumulative Drainage Area (square miles)	0.29	0.40	0.44	1.01
Adjustment of PMF for Drainage Area (%) ⁽¹⁾				
6 hours	117	117	117	117
12 hours	127	127	127	127
24 hours	136	136	136	136
48 hours	143	143	143	143
72 hours	145	145	145	145
Snyder Hydrograph Parameters				
Zone ⁽²⁾	13	13	13	13
C _p ⁽³⁾	0.50	0.50	0.50	0.50
C _t ⁽³⁾	1.85	1.85	1.85	1.85
L (miles) ⁽⁴⁾	0.40	0.40	0.19	0.85
L _{ca} (miles) ⁽⁴⁾	0.20	0.20	0.10	0.40
tp = C _t (LxL _{ca}) 0.3 hrs.	0.87	0.87	0.56	1.34
Spillway Data	Lt.	Rt.		
Crest Length (ft)	9	26	39	10
Freeboard (ft)	3.5	3.1	3.0	2.6
Discharge Coefficient	3.1	C'=0.95	C'=0.95	C'=0.95
Exponent	1.5	N/A	N/A	N/A

- (1) Hydrometeorological Report 40 (Figure 1), U.S. Army Corps of Engineers, 1965.
- (2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).
- (3) Snyder's Coefficients.
- (4) L=Length of longest water course from outlet to basin divide.
L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: D.A. = 1.01 mi² Wooded Steep Slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 33 ac.ft.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 40 ac.ft.

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1497.6 feet

SPILLWAY CREST:

- a. Elevation 1495 feet
- b. Type Trapezoidal
- c. Width 35 feet - bottom
- d. Length Channel approximately 200'
- e. Location Spillover Left abutment
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type 10" CIP
- b. Location Near original stream bottom
- c. Entrance inverts Unknown
- d. Exit inverts Unknown
- e. Emergency draindown facilities 10" CIP

HYDROMETEOROLOGICAL GAUGES:

- a. Type None
- b. Location None
- c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown



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DAM NAME KEELY RUN No. 3

I.D. NUMBER 54-17

SHEET NO. 1 OF 6

BY OTM DATE 1-23-80

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS,
BALTIMORE DISTRICT.

STRTL = 1 INCH
CNSTL = 0.05 IN/HR
STR TQ = 1.5 CFS / MI.²
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.0

ELEVATION-AREA-CAPACITY RELATIONSHIPS

FROM U.S.G.S. 7.5 MIN. QUAD, DER FILES AND
FIELD INSPECTION DATA.

AT SPILLWAY CREST ELEVATION = 1495'
INITIAL STORAGE = 33.2 AC.FT.
POND SURFACE AREA = 2.4 ACRES

AT ELEV. 1500', AREA = 3.7 ACRES
AT ELEV. 1520', AREA = 6.4 ACRES

FROM CONIC METHOD FOR RESERVOIR VOLUME.
FLOOD HYDROGRAPH PACKAGE (HEC-1),
DAM SAFETY VERSION (USERS MANUAL).

$$\begin{aligned} H &= 3V/A \\ &= 3(33.2)/2.4 \\ &= 99.6/2.4 \\ &= 41.5' \end{aligned}$$

ELEVATION WHERE AREA EQUALS ZERO;

$$1495' - 41.5' = 1453.5'$$

AREA	\$A	0	2.4	3.7	6.4
ELEV.	\$E	1453.5	1495	1500	1520



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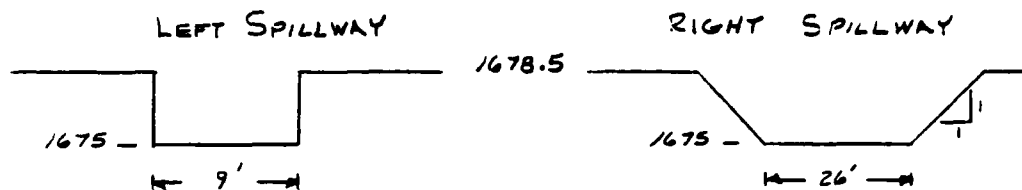
DAM NAME KEHLY RUN No. 3

I.D. NUMBER 54-17

SHEET NO. 2 OF 6

BY OTM DATE 2-26-80

DISCHARGE RATING CURVE (KEHLY RUN No. 6)



(NOT TO SCALE)

ELEV. (FT.)	LEFT SPILLWAY		RIGHT SPILLWAY		* DISCHARGE Q (cfs)
	h_1 (FT)	Q_1 (cfs)	h_2 (FT)	Q_2 (cfs)	
1675	0	0	0	0	0
1676	1	28	1	78	110
1677	2	79	2	227	310
1678	3	145	3	428	570
1678.5	3.5	183	3.5	545	730
1679	4	223	4	674	900
1680	5	312	5	965	1230
1685	10	882	10	3053	3940
1690	15	1621	15	6213	7830

* VALUES ROUNDED TO NEAREST 10 cfs.



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DAM NAME KEHLY RUN No. 3

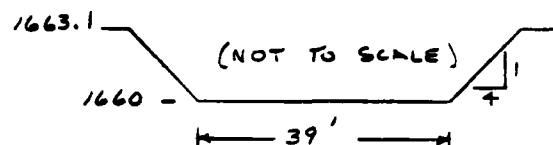
I.D. NUMBER 54-17

SHEET NO. 3 OF 6

BY OTM DATE 2-26-80

DISCHARGE RATING CURVE (KEHLY RUN No. 5)

ELEV. (FT.)	hP (FT.)	*Q (cfs)
1660	0	0
1660.5	.5	40
1661	1	120
1661.5	1.5	230
1662	2	370
1662.5	2.5	530
1663	3	720
1664	4	1180
1665	5	1740
1670	10	6240



*VALUES ROUNDED TO
NEAREST 10 cfs.

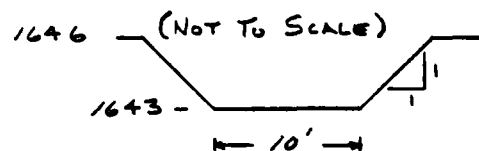
$$B = 39'$$

$$Z = 1$$

$$C' = 0.95$$

DISCHARGE RATING CURVE (KEHLY RUN No. 4)

ELEV (FT)	hP (FT)	*Q (cfs)
1643	0	0
1643.5	.5	10
1644	1	30
1644.5	1.5	60
1645	2	90
1645.5	2.5	140
1646	3	180
1648	5	440
1650	7	810
1660	17	4563



*VALUES ROUNDED TO
NEAREST 10 cfs.

$$B = 10'$$

$$Z = 1$$

$$C' = 0.95$$



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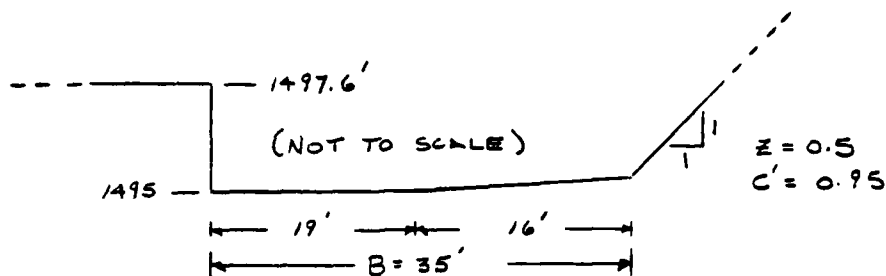
DAM NAME KEHLY RUN No. 3

I.D. NUMBER 54-17

SHEET NO. 4 OF 6

BY OTM DATE 1-24-80

DISCHARGE RATING CURVE (KEHLY RUN No. 3)



ELEV. (FT.)	h _p (FT.)	* Q (cfs)
1495	0	0
1495.5	.5	40
1496	1	100
1496.5	1.5	190
1497	2	300
1497.5	2.5	420
1498	3	550
1500	5	1200
1505	10	3560
1510	15	6840

* VALUES ROUNDED
TO NEAREST
10 cfs.

$$\text{FROM: } Q = 8.03 C' h_v^{1/2} (h_p - h_v) [B + z (h_p - h_v)]$$

$$\text{WHERE } h_v = \frac{3(z \pm h_p + B) - (16z^2 h_p^2 + 16z B h_p + 9B^2)^{1/2}}{10z}$$

SOURCE: WATER & WASTEWATER ENGINEERING
by FAIR, GEYER & OKUM 1966 p.(11-14) & (11-15)

LOW DAMS
by NATIONAL RESOURCES COMMITTEE WASH. DC.
1938 Eq. (7) & (8)



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DAM NAME KEHLY RUN No. 3

I.D. NUMBER 54-17

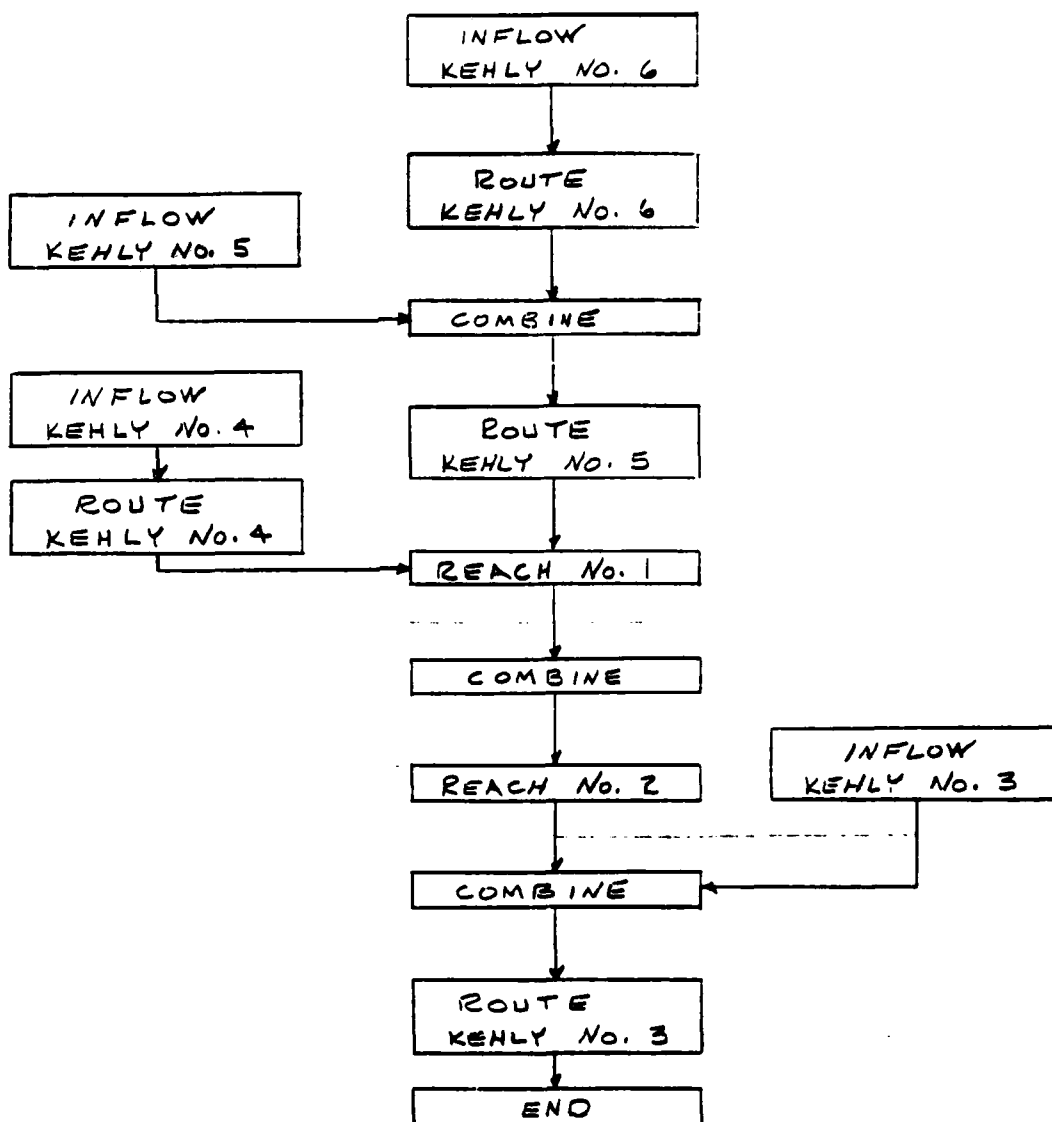
SHEET NO. 5 OF 6

BY OTM DATE 1-24-80

OVERTOP PARAMETERS

TOP OF DAM ELEV. (LOW SPOT) = 1497.6'
LENGTH OF DAM (EXCLUDING SPILLWAY) = 442'
COEFFICIENT OF DISCHARGE (C) = 3.0 (BROAD CREST)
\$ L_{MAX} = N/A } ASSUMED ENTIRE CREST
\$ V_{MAX} = N/A } ELEV. 1497.6'

PROGRAM SCHEDULE - UPSTREAM DAM CONSIDERATION



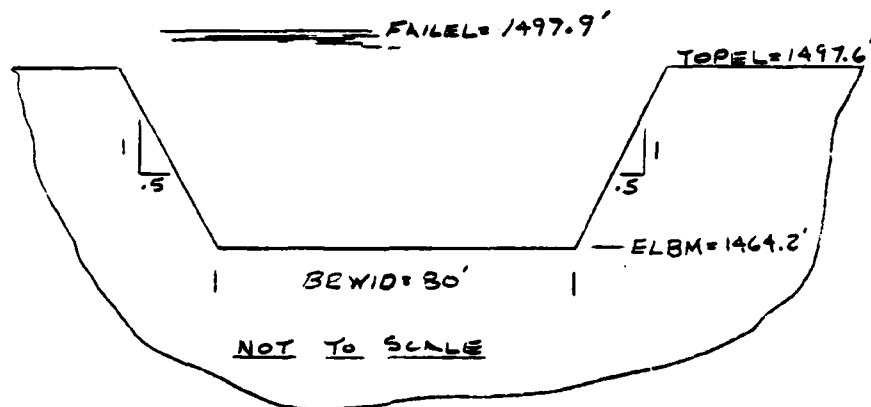


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DAM NAME KEHLY RUN DAM No. 3
I.D. NUMBER 54-17

SHEET NO. 6 OF 6
BY OTM DATE 1-80

DAM BREACH PARAMETERS



RATIO OF PMF (RTIO) = 0.30
SIDE SLOPE OF BREACH (Z) = 0.5
FAILURE TIME (TFAIL) = 2 HRS.

CHANNEL ROUTING

CHANNEL CROSS SECTIONS OBTAINED FROM
U.S.G.S. QUND.

CHANNEL MANNING'S n , $Q_N(2) = 0.05$

OVERBANK MANNING'S n , $Q_N(1) = 0.06$

***** FLOOD HYDROGRAPH PACKAGE (HEC-1) DAM SAFETY VERSION JULY 1978 LAST MODIFICATION 26 FEB 79 *****														
1	A1	ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF												
2	A2	HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF KEHLY RUN NO. 3												
3	A3	RATIOS OF PMF ROUTED THROUGH THE RESERVOIR PA. 54-19												
4	B	288	0	15	0	0	0	0	0	0	0	0	0	0
5	B1	5												
6	J	1	6	1										
7	J1	21	23	25	27	29	31	33	35	37	39	41	43	45
8	K	0	1											
9	K1	INFLOW TO RESERVOIR NO. 6												
10	M	1	1	0.29										
11	P	22.3	117	127	136	143	145	1.0	0.05					
12	T													
13	W	0.87	0.50											
14	X	-1.5	-0.9	2.0										
15	K	1	2											
16	K1	ROUTE THRU KEHLY RESERVOIR NO. 6												
17	Y	1	1											
18	V1	1												
19	V4	1675	1678	1677	1678	1678.5	1679	900	1280	1885	1890			
20	V5	0	110	310	570	730	900	1280	1885	1890				
21	SA	0	21	46	92									
22	SE	1689	1675	1680	1700									
23	SS	1675												
24	SD1678.5	3.0	1.5	1200										
25	K	0	3											
26	K1	INFLOW TO RESERVOIR NO. 5												
27	M	1	1	0.11										
28	P	22.3	117	127	136	143	145	1.0	0.05					
29	T													
30	W	0.87	0.50											
31	X	-1.5	-0.9	2.0										
32	K	2	A											
33	K1	COMBINE												
34	K	1	5											
35	K1	ROUTE THRU RESERVOIR NO. 5												
36	Y	1	1											
37	V1	1												
38	V4	1660	1660.5	1661	1661.5	1662	1662.5	1663	1664	1665	1670			
39	V5	0	40	120	230	370	530	720	1180	1740	6240			
40	SA	0	8	23										
41	SE1639.7	1660	1680											
42	SS	1660												
43	SD1663.1	3.0	1.5	1150										
44	K	1	6											
45	K1	CHANNEL ROUTING - MUD PULS REACH 1												
46	Y	1	1											
47	V1	1												
48	V6	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
49	V7	0	1660	350	1640	600	1220	601	1618	604	1618			
50	V7	605	1620	850	1640	1100	1660							

 FLOOD HYDROGRAPH PACKAGE (HFC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE: 80/01/24
 TIME: 05:35:34

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF KEHLY RUN NO. 3
 RATIOS OF PMF ROUTED THROUGH THE RESERVOIR PA. 54-19

JOB SPECIFICATION

NO	NHR	MMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	INSTAN
208	0	15	0	0	0	0	0	0	0
	JOPER			NWT	LROPI	TRACE			
	5			0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED

PLAN 1 RATIOS 5 LRTIOS 1
 RATIOS= .10 .30 .50 .70 .90 1.00

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 6

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

THYDG	TUNG	TAREA	SNAP	TRSDA	TRSPC	RATTO	TSNOW	TSARE	LOCAL
1	1	.29	0.00	.29	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	143.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .600

LOSS DATA

LROPI	STYR	CLYR	RYOL	ERAIN	STRS	RYOK	STYTL	CHSTL	ALSHX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNITY HYDROGRAPH DATA

TP= .87 C= .50 NIA= 0

RECESSION DATA

STRIO= -1.50 ORCSN= -.05 RTIOR= 2.00
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.67 AND R= 4.76 INTERVALS

UNIT HYDROGRAPH 28 END-OF-PERIOD ORDINATES, LAG= .87 HOURS, CP= .50 VOL= 1.00

14.	52.	91.	105.	93.	75.	61.	49.	40.	3..
26.	21.	17.	14.	11.	9.	7.	6.	5.	4.

HYDROGRAPH ROUTING

ROUTE THRU KENLY RESERVOIR NO. 6

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

LOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

STAGE	1675.00	1676.00	1677.00	1678.00	1678.50	1679.00	1680.00	1685.00	1690.00
FLOW	0.00	110.00	310.00	570.00	730.00	900.00	1280.00	3940.00	7830.00

SURFACE AREA= 0. 21. 46. 92.

CAPACITY= 0. 42. 205. 1559.

ELEVATION= 1659. 1675. 1680. 1700.

CREL	SPWID	COOW	EXPW	ELEV	COOL	CAREA	EXPL
1675.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWTD
1678.5	3.0	1.5	1200.

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 5

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INYS	IUNQ	TAREA	SNAP	TRSDA	TRSPC	RATTO	TSNOW	ISAME	LOCAL
1	1	.11	0.00	.11	0.00	0.000	0	1	0

PRECIP DATA

SPFE	WMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM, IS .800

LOSS DATA

LROPT	STHR	DLTR	RTOL	ERAIN	STRES	RTIOK	STRTL	CNSTL	ALSHX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

1P= .87 CP= .50 NTA= 0

RECESSION DATA

STRTU= -1.50 GRCSN= -.05 RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND 1P ARE TC= 3.67 AND R= 4.76 INTERVALS

UNIT	HYDROGRAPH 28	END-OF-PERIOD	ORDINATES, LAG=	.87 HOURS, CP=	.90	VOL=
5.	20.	34.	40.	28.	23.	19.
10.	8.	6.	5.	4.	3.	2.
1.	1.	1.	1.	0.	0.	0.

END-OF-PERIOD FLOW

4/9

ROUTE THRU RESERVOIR NO. 5

DAM DATA

V

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HYDROGRAPH ROUTING

CHANNEL ROUTING - MOD PUL'S REACH 1

ISTAU	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRIS	ISAME	ICP1	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSIDL	LAG	AMSKK	X	ISK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QNI(1)	QNI(2)	QNI(3)	ELNVT	ELMAX	RLNTH	SEL
0.000	0.000	0.000	1618.0	1640.0	850.	0.04710

CROSS SECTION COORDINATES--STA+ELEV+STA+ELEV--ETC

0.00	1660.00	350.00	1640.00	600.00	1620.00	601.00	1618.00	604.00	1618.00
605.00	1620.00	850.00	1640.00	1100.00	1660.00				

STORAGE	0.00	.19	1.81	5.79	12.13	20.83	31.89	45.31	61.09
26279.23									
86410.91	99.73	122.86	148.88	177.71	209.83	248.00	281.44	321.74	366.89

OUTFLOW	0.00	67.19	694.61	3320.89	7939.39	16199.05	28470.22	45370.36	67471.72
95339.84	129388.25	168673.32	215815.92	271392.95	335972.05	410108.72	494345.67	589213.05	695229.08
51290.73									

STAGE	1618.00	1620.21	1622.42	1624.63	1626.84	1629.05	1631.26	1633.47	1635.68
1637.89	1640.11	1642.32	1644.53	1646.74	1648.95	1651.16	1653.37	1655.58	1657.79
1660.00									

FLOW	0.00	67.19	694.61	3020.89	7939.39	16199.05	28470.22	45370.36	67471.72
95339.84	129388.25	168673.32	215815.92	271392.95	335972.05	410108.72	494345.67	589213.05	695229.08

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SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 4

ISTAQ	ICOMP	TECON	ITYPE	JPCY	JPRY	INAME	ISTAGE	TAUTO
7	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INVDG	IUNG	TAREA	SNAP	TMSDA	TNSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.04	0.00	.04	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TNSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STKR	DLTR	RTOL	ERAIN	STKS	RTOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= .56 CP= .50 NIA= 0

RECESSION DATA

STRTQ= -1.50 ORCSN= -.05 RTIOR= 2.00
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 2.35 AND R= 3.03 INTERVALS

UNIT HYDROGRAPH 18 END-OF-PERIOD ORIGINATES. LAG= .56 HOURS. CP= .50 VOL= 1.00
 6. 18. 21. 17. 12. 9. 6. 4. 3. 2.

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HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 4

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	1	0	0	0	0	1	0	0

ROUTING DATA

	QLOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR
	0.0	0.000	0.00	1	1	0	0	0
		NSIPS	NSIDL	LAG	AMSKK	X	TSK	ISPRAT
		1	0	0	0.000	0.000	0.000	-1

SURFACE AREA= 0. 1. 7.

CAPACITY= 0. 12. 74.

ELEVATION= 1615. 1643. 1660.

CREL	SPWID	COBW	EXPW	ELEV	COOL	CAREA	EXPL
1643.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA
TOPEL COOD EXPD DAMWID
1643.0 0.0 1.0 1.0

HYDROGRAPH ROUTING

CHANNEL ROUTING - MOD PULS REACH 2

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRY	INAME	ISTAGE	IAUTO
10	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

MSPTS	MSIDL	LAG	AMSK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0	0

VERTICAL DEPTH CHANNEL ROUTING

ON(1)	ON(2)	ON(3)	ELNVT	ELMAX	RLNTH	SEL
0.000	0.0500	0.0600	1498.0	1540.0	1600	0.07500

CROSS SECTION COORDINATES==STATELEV:STATELEV==ETC

0.00	1540.00	90.00	1520.00	200.00	1500.00	201.00	1498.00	204.00	1498.00
205.00	1500.00	350.00	1520.00	390.00	1540.00				

STORAGE	0.00	34	2.11	6.17	12.51	21.15	32.07	45.28	60.78
433878.56	98.64	120.39	143.30	167.39	192.64	219.05	246.63	275.38	305.30

OUTFLOW	0.000	84.39	803.70	2273.33	3863.02	11892.24	19471.04	30718.07	43359.13
63752.48	86364.10	115821.44	149424.58	187209.00	229227.01	275942.52	326227.59	381360.18	441022.59

STAGE	1498.00	1500.21	1502.42	1504.63	1506.84	1509.05	1511.26	1513.47	1515.68
1517.89	1520.11	1522.32	1524.53	1526.74	1528.95	1531.16	1533.37	1535.58	1537.79

FLOW	0.00	84.39	603.70	2273.33	5663.02	11252.24	19471.04	30716.07	43359.13
63752.48	86364.10	115821.44	149424.58	187209.00	229227.01	275942.52	326227.59	381360.18	441022.59

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 3

ISTRD	ICOMP	TECON	ITYPE	JPLT	JPRF	INAME	ISTAGE	TAUTO
11	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IMYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.57	0.00	.57	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	145.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STNKR	DLTKR	RTIOL	ERAIN	STNKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

IP= 1.34 CP= .50 NTA= 0

RECESSION DATA

STRIO= -1.50 QRCNM= .05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.89 AND N= 7.21 INTERVALS

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 3

STAGE	1495.00	1495.50	1496.00	1496.50	1497.00	1497.50	1498.00	1500.00	1505.00
FLOW	0.00	40.00	100.00	190.00	300.00	420.00	550.00	1200.00	3560.00
SURFACE AREA	0.	2.	4.	6.					
CAPACITY	0.	33.	48.	148.					
ELEVATION	1454.	1495.	1500.	1520.					
CREL	1495.0	1495.0	1495.0	1495.0	1495.0	1495.0	1495.0	1495.0	1495.0
SPWID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COOH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ELFVL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAREA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	1497.6
COOD	3.0
EXPW	1.5
DAMWID	442.

13/17

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS					
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
				.10	.30	.50	.70	.90	1.00
HYDROGRAPH AT	1	.29	1	102.	306.	511.	715.	919.	1021.
		.751		2.8911	8.6711	14.2611	20.2411	26.0211	28.9211
ROUTED TO	2	.29	1	60.	199.	344.	493.	641.	717.
		.679		1.8711	5.6811	9.7911	13.9911	18.1811	20.2911
HYDROGRAPH AT	3	.11	1	39.	116.	194.	271.	349.	387.
		.287		1.1011	3.2711	5.4811	7.6811	9.8711	10.9711
2 COMBINED	4	.40	1	87.	282.	486.	697.	904.	1012.
		1.067		2.5711	7.9911	13.6711	19.7311	25.8111	28.8411
ROUTED TO	5	.40	1	84.	276.	478.	687.	906.	1012.
		1.067		2.3711	7.6211	13.3411	19.4511	25.5611	28.6711
ROUTED TO	6	.40	1	84.	276.	478.	687.	905.	1015.
		1.067		2.3711	7.6211	13.3411	19.4511	25.5711	28.7611
HYDROGRAPH AT	7	.04	1	18.	53.	88.	123.	158.	175.
		.107		.5011	1.4311	2.4811	3.4711	4.4611	4.9811
ROUTED TO	8	.04	1	14.	46.	78.	112.	145.	160.
		.107		.4011	1.3211	2.2011	3.1811	4.1011	4.5311
2 COMBINED	9	.44	1	73.	305.	529.	762.	1020.	1139.
		1.141		2.6311	8.6411	14.9711	21.5611	29.8711	32.2511
ROUTED TO	10	.44	1	93.	305.	528.	761.	1017.	1149.
		1.141		2.6311	8.6311	14.9511	21.5511	28.8111	32.5411
HYDROGRAPH AT	11	.57	1	161.	486.	807.	1130.	1453.	1615.
		1.581		4.5711	13.7211	22.8611	37.0111	41.1511	45.7211
2 COMBINED	12	1.01	1	246.	769.	1314.	1866.	2471.	2764.
		2.621		6.9711	21.7811	37.7211	52.8411	69.9611	78.2611
ROUTED TO	13	1.01	1	245.	769.	1315.	1866.	2469.	2767.
		2.621		6.9311	21.7811	37.7411	52.8311	69.9111	78.3611

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	1675.00	1675.00	1678.50
OUTFLOW	42.0	42.0	143.0
	0.0	0.0	730.0

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.30	1676.53	0.00	77.0	199.0	0.00	42.00	0.00
0.50	1677.13	0.00	97.0	344.0	0.00	41.75	0.00
0.70	1677.70	0.00	115.0	493.0	0.00	41.75	0.00
0.90	1678.22	0.00	133.0	641.0	0.00	41.75	0.00
1.00	1678.46	0.00	141.0	717.0	0.00	41.75	0.00

13/17

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	1660.00	1660.00	1663.10	
	STORAGE	34.	84.	82.
	OUTFLOW	0.	0.	766.

RATIO OF	MAXIMUM RESERVOIR	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1660.77	0.00	60.	84.	0.00	42.25	0.00
.30	1661.66	0.00	68.	276.	0.00	41.75	0.00
.50	1662.34	0.00	74.	478.	0.00	41.75	0.00
.70	1662.91	0.00	80.	687.	0.00	41.50	0.00
.90	1663.19	.09	83.	908.	2.00	41.00	0.00
1.00	1663.24	.14	85.	1012.	2.75	41.25	0.00

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW CFS	MAXIMUM STAGE FT	TIME HOURS
.10	84.	1620.3	42.25
.30	276.	1620.9	42.00
.50	478.	1621.7	41.75
.70	687.	1622.6	41.50
.90	908.	1622.6	41.25
1.00	1015.	1622.7	41.50

15/12

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TUP OF DAM
	1643.00	1643.00	1646.00
ELEVATION	12.	12.	17.
STORAGE	0.	0.	180.
OUTFLOW			

RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1643.60	0.00	13.	14.	0.00	40.75	0.00
.30	1644.27	0.00	14.	26.	0.00	40.50	0.00
.50	1644.79	0.00	15.	78.	0.00	40.50	0.00
.70	1645.22	0.00	16.	112.	0.00	40.50	0.00
.90	1645.56	0.00	16.	143.	0.00	40.50	0.00
1.00	1645.75	0.00	17.	160.	0.00	40.50	0.00

PLAN 1 STATION 10

RATIO	MAXIMUM FLOW CFS	MAXIMUM STAGE FT	TIME HOURS
.10	93.	1500.2	42.00
.30	305.	1501.1	41.75
.50	528.	1502.1	41.50
.70	761.	1502.6	41.50
.90	1017.	1503.0	41.00
1.00	1149.	1503.1	41.00

12/1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION INITIAL VALUE SPILLWAY CREST TOP OF DAM
STORAGE 1495.00 1495.00 1497.60
OUTFLOW 0. 0. 446.

RATIO OF PMF	MAXIMUM RESERVOIR ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1496.75	0.00	38.	245.	0.00	41.25	0.00
.30	1497.92	.32	41.	769.	3.50	41.25	0.00
.50	1498.24	.64	42.	1315.	6.00	41.25	0.00
.70	1498.51	.91	43.	1866.	7.50	41.25	0.00
.90	1498.77	1.17	44.	2467.	8.50	41.00	0.00
1.00	1498.88	1.28	44.	2767.	8.75	41.00	0.00

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

 1 K1 ROUTE OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
 2 A2 DOWNSTREAM CONDITION DUE TO OVERTOP (KEHLY RUN NO. 3 - 54-19)
 3 A3 PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH

4	B	288	0	15	0	0	0	0	0
5	B1	5	1	1					
6	J	2							
7	J1	0.3							
8	K	0	1						
9	K1								
10	M	1	0.27						
11	P	22.3	117	127	136	143	145		
12	I						1.0	0.05	
13	W	0.87	0.50						
14	X	-1.06	-0.05	2.0					
15	K	1	2						
16	K1								
17	Y								
18	Y1	1							
19	Y4	1675	1676	1677	1678	1678.5	1679	1680	1683
20	Y5	0	110	310	570	730	900	1280	1690
21	Y4	0	21	46	92				7830
22	SE	1659	1675	1680	1700				
23	SS	1675							
24	SD1678.5	3.0	1.5	1200					
25	K	0							
26	K1								
27	M	1	0.11						
28	P	22.3	117	127	136	143	145		
29	I						1.0	0.05	
30	W	0.87	0.50						
31	X	-1.06	-0.05	2.0					
32	K	2							
33	K1								
34	F	1							
35	K1								
36	Y								
37	Y1	1							
38	Y4	1660	1660.5	1661	1661.5	1662	1662.5	1663	1664
39	Y5	0	40	120	230	370	530	720	1180
40	Y4	0	23						1665
41	SL1639.7	1660	1680						1670
42	SS	1660							1740
43	SD1653.1	3.0	1.5	1150					6240
44	K	1							
45	K1								
46	Y								
47	Y1	1							
48	Y6	0.06	0.05	0.06	0.18	0.50	0.50	0.0471	
49	Y7	0	1660	350	1640	600	1620	601	1618
50	Y7	605	1620	850	1640	1100	1660	604	1618

 CHANNEL ROUTING - MOD PULS REACH 1

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE* 80/01/28.
 TIME* 10.48.21.

RATIO OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
 DOWNSTREAM CONDITION DUE TO OVERTOP (KEHLY RUN NO. 3 - 54-19)
 PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH

JOB SPECIFICATION

NO	NHR	NHIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
209	0	15	0	0	0	0	0	0	0
		JOPER		NWT	LRBPT	TRACE			
		5		0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED

PLAN= 2 RATIO= 1, LNTON= 1

RTIOS= .30

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 6

ISTAG	ICOMP	IECON	ITAPE	JPLT	INAME	ISTAGE	IAUTO
1	0	0	0	0	1	0	0

HYDROGRAPH DATA

TRYDG	TURG	TAREA	SNAP	TRSDA	TRSPC	RATIO	TSNOW	TSAME	LOCAL
1	1	.29	0.00	.29	0.00	0.000	0	1	0

PRECIP DATA

SPFE	RMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LRBPT	STKRN	DLTKR	RYTOL	ERATN	STKRS	RTIOK	STRYL	CNSYL	ALSMX	RYTMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNITY HYDROGRAPH DATA

TP= .87 CP= .50 NTA= 0

RECESSION DATA

STRTG= -1.50 ORCSN= -.05 RTIOR= 2.00
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.67 AND R= 4.16 INTERVALS

UNIT	HYDROGRAPH	28	END-OF-PERIOD	ORDINATES	LAG=	HR	HOURS	CP=	50	VOL=	1.00
14.	52.	91.	105.	93.	75.	61.	49.	40.	34.		
26.	21.	17.	12.	11.	9.	7.	6.	5.	4.		

719

HYDROGRAPH ROUTING

ROUTE THRU KENLY RESERVOIR NO. 6

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRI	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME

ROUTING DATA

QLOSS	CLOSS	AVG	IRIS	ISAME	TOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

INSTPS	NSIDL	LAG	ANSKK	X	TSK	STORA	TSPRAY
1	0	0	0.000	-0.000	0.000	-1675.	-1

STAGE	1675.00	1676.00	1677.00	1678.00	1678.50	1679.00	1680.00	1685.00	1690.00
FLOW	0.00	110.00	310.00	570.00	730.00	900.00	1280.00	3940.00	7830.00

SURFACE AREA= 0. 21. 46. 92.

CAPACITY= 0. 42. 205. 1559.

ELEVATION= 1669. 1675. 1680. 1700.

CREL	SPWID	COQM	EXPW	ELEVL	COOL	CARLA	EXPL
1675.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	CROD	EXPD	DAMWID
1676.5	3.0	1.5	1200.

619

INFLOW TO RESERVOIR NO. 5

ISTAG	ICOMP	IICON	JTAPE	JPLI	JPRI	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	0	0	0

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HYDROGRAPH DATA

HYDROGRAPH DATA									
THWBG	TUHG	YAREA	SNAP	THSDA	TRSPC	RATIO	TSNOW	TSAME	LOCAL
1	1	.11	0.00	.11	0.30	0.000	0	1	0

PRECIP DATA

	SPFE	PMS	R6	R12	R24	R48	R72	R96
	0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUED BY THE PROGRAM IS 0.00 22

16

LOSS DATA

CROPT		LOSS DATA					COST		
STKR	DLTKR	KTOL	ERATL	STKRS	RTTOR	STYLT	ENSTL	ALSNR	RTYMP
6	0.00	0.00	0.00	0.00	1.00	1.00	0.0	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 0.87 CP= 0.50 NIA= 0

REGRESSION DATA

REGRESSION DATA

STRLO=	-1.50	QRCSN=	-.005	RTOR=	2.00
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APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNUYER CP AND TP ARF TC= 3.67 AND N= 4.76 INTERVALS

UNIT HYDROGRAPH 28 END-OF-PERIOD ORDINATES, LAG=										.87 HOURS, CP=		.50 VOL=1.00	
5.	20.	34.	40.	5.	35.	28.	23.	19.	15.				
10.	8.	6.	5.	4.	4.	3.	3.	2.	2.				
1.	1.	1.	1.	1.	1.	0.	0.	0.	0.				

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 5

STAGE 1670.00 1660.50 1661.00 1661.50 1662.00 1662.50 1663.00 1664.00 1665.00

FLOW 0.00 40.00 120.00 230.00 370.00 530.00 720.00 1180.00 1740.00

SURFACE AREA= 0. 8. 23.

CAPACITY= 0. 54. 351.

ELEVATION= 1640. 1660. 1680.

CRLL SPWID COUW EXPW FLEVL COUL CARLA EXPL

DAM DATA

TOPEL COGC PRD DAMWID

1663.1 3.0 1.5 1150.

STATION 5. PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0. 0. 0. 0. 0. 0. 0. 0. 0.

HYDROGRAPH ROUTING

CHANNEL ROUTING - MOD PULS REACH-1

ISTAU	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

CROSS	CLOSS	AVG	TRES	TSAME	TOPT	TPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSYPS	NSYDL	LAG	AMSK	X	TSK	SYORA	TSPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

OR(1)	OR(2)	OR(3)	ELNVT	FLMAX	RLNTH	SEL
0.000	0.0500	0.0600	1618.0	1660.0	250.	0.04710

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00	1600.00	350.00	1640.00	500.00	1620.00	501.00	1518.00	504.00	1618.00
605.00	1620.00	850.00	1640.00	1100.00	1660.00				

STORAGE	0.00	0.19	1.81	5.79	12.13	20.83	31.89	45.31	61.09
7/6279.23	99.73	122.86	148.86	177.71	209.43	244.00	281.44	321.74	364.89

OUTFLOW	0.00	67.19	694.61	3020.89	7939.39	16199.05	28470.22	45370.36	67477.72
95339.84	129388.25	168673.32	215815.92	271392.95	339972.05	410108.72	494345.67	589213.05	695229.08

STAGE	1618.00	1620.21	1622.42	1624.63	1626.84	1629.05	1631.26	1633.47	1635.68
1/1637.89	1640.11	1642.32	1644.53	1646.74	1648.95	1651.16	1653.37	1655.58	1657.79

FLOW	0.00	67.19	694.61	3020.89	7939.39	16199.05	28470.22	45370.36	67477.72
695339.84	129388.25	168673.32	215815.92	271392.95	339972.05	410108.72	494345.67	589213.05	695229.08

STAGE	1618.00	1620.21	1622.42	1624.63	1626.84	1629.05	1631.26	1633.47	1635.68
1/1637.89	1640.11	1642.32	1644.53	1646.74	1648.95	1651.16	1653.37	1655.58	1657.79

FLOW	0.00	67.19	694.61	3020.89	7939.39	16199.05	28470.22	45370.36	67477.72
695339.84	129388.25	168673.32	215815.92	271392.95	339972.05	410108.72	494345.67	589213.05	695229.08

STAGE	1618.00	1620.21	1622.42	1624.63	1626.84	1629.05	1631.26	1633.47	1635.68
1/1637.89	1640.11	1642.32	1644.53	1646.74	1648.95	1651.16	1653.37	1655.58	1657.79

FLOW	0.00	67.19	694.61	3020.89	7939.39	16199.05	28470.22	45370.36	67477.72
695339.84	129388.25	168673.32	215815.92	271392.95	339972.05	410108.72	494345.67	589213.05	695229.08

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SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 4

ISYAO 7 ICOMP 0 ITECON 0 IYAPE 0 JPLY 0 JPRY 0 IFRAME 1 ISTAGE 0 IAUVO 0

HYDROGRAPH DATA

IHYDG 1 IUNG 1 TAREA .04 SNAP 0.00 TRSDA .04 TRSFC 0.00 RATIO 0.000 ISNOW 0 ISAML 1 LOCAL 0

PRECIP DATA

SPFE 0.00 PMS 22.30 R6 117.00 R12 127.00 R24 136.00 R48 143.00 R72 145.00 R96 0.00

TPSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT 0 STRKR 0.00 DLTKR 0.00 RTIOL 1.00 ERAIN 0.00 STNKS 0.00 RTIOK 1.00 STRTL 1.00 CNSTL .05 ALSMX 0.00 RTIMP 0.00

UNIT HYDROGRAPH DATA

TP= .50 CP= .50 NIA= 0

RECESSION DATA

STRTO= -1.00 ORCSN= -.05 RTTOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 2.35 AND RE= 3.03 INTERVALS

UNIT HYDROGRAPH 18 LNU-OF-PIRIOD ORIGINATES, LAG= .56 HOURS, CP= .50 VOL= 1.00

6	18	21	1	17	12	9	6	4	3	2
2	1	1	1	1	0	0	0	0	0	0

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 6

ISTAO 8 ICOMP 1 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 1 IAUO 0

ALL PLANS HAVE SAME ROUTING DATA

GLSS 0.0 CLOS 0.000 AVG 0.000 IRES 1 TSAME 1 TOPT 0 TPMP 0 LSTR 0

NSIPS 1 NSTDL 0 LAG 0 AMSKK 0 TSK 0 STORA 1 SPRAT -1

STAGE 1643.00 1643.50 1644.00 1644.50 1645.00 1645.50 1646.00 1648.00 1650.00

//1660.00

FLON 0.00 10.00 30.00 60.00 90.00 140.00 180.00 440.00 810.00

279963.00

SURFACE AREA= 0. 1. 7.

CAPACITY= 0. 12. 74.

ELEVATION= 1615. 1643. 1660.

CREL 1643.0 SPWID 0.0 CROW 0.0 EXPW 0.0 TTFVL 0.0 CORR 0.0 CARTA 0.0 EXPL 0.0

DAM DATA
TOPEL 1644.0 COORD 7.0 EXPD 1.5 DAMWID 6.0

11/19

CHANNEL ROUTING - MOIP PUL'S REACH 2

ISTAU	ICOMP	IECON	ITAPE	JPLT	JPR1	INAME	ISTAGE	IAUTO
00	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME
ROUTING DATA

NO. 1000						
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NSIPS	INSTDL	LAG	AMSKK	X	CSK	3 FORA	ISPRAT
0.0000	0.00	1	1	1	0	0	0
1	0	0	0.0000	0.0000	0.0000	0.0000	0

INSTPS	NSTD	LAG	AMSKK	X	FSK	5.0RA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QNT17	QNT21	QNT27	ELNVT	ELMAX	RLNTH	SEL
00600	0500	0800	1499.0	1543.0	1600	07500

CROSS SECTION COORDINATES--SIA,LLEV,SIA,FLEV--ETC

0500	1340.00	90.00	1920.00	200.00	1300.00	201.00	1498.00	204.00	1494.00
205.00	1500.00	350.00	1920.00	390.00	1560.00				

STORAGE	0.00	.34	2.11	6.17	12.31	71.13	32.07	45.28	60.78
//1678.56									

7/1336038	20004	420037	843620	107637	192804	219603	250603	275638	305638
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263752.48	86364.10	11582.144	14942.454	18720.900	22922.101	27586.252	32627.150	38196.018	44102.369	50559.110	57559.110	65059.110	73059.110	81559.110	90559.110	100059.110	110059.110	120559.110	131559.110	143059.110	155059.110	167559.110	181059.110	195559.110	211059.110	228559.110	247059.110	267559.110	289059.110	311559.110	336059.110	362559.110	391059.110	421559.110	454059.110	488559.110	525059.110	563559.110	604059.110	646559.110	691059.110	737559.110	786059.110	836559.110	889059.110	943559.110	1000059.110	1058559.110	1119059.110	1181559.110	1246059.110	1312559.110	1381059.110	1451559.110	1524059.110	1598559.110	1675059.110	1753559.110	1834059.110	1916559.110	2001059.110	2087559.110	2176059.110	2266559.110	2359059.110	2453559.110	2550059.110	2648559.110	2749059.110	2851559.110	2956059.110	3062559.110	3171059.110	3281559.110	3394059.110	3508559.110	3625059.110	3743559.110	3864059.110	3986559.110	4111059.110	4237559.110	4366059.110	4496559.110	4629059.110	4763559.110	4900059.110	5038559.110	5179059.110	5321559.110	5466059.110	5613559.110	5763059.110	5915559.110	6070559.110	6228059.110	6388559.110	6551059.110	6715559.110	6882059.110	7051559.110	7223559.110	7398059.110	7575559.110	7756059.110	7939559.110	8125559.110	8314059.110	8505559.110	8699559.110	8896059.110	9095559.110	9297559.110	9502059.110	9709559.110	9919559.110	10132559.110	10348559.110	10567559.110	10789559.110	11014559.110	11242559.110	11473559.110	11707559.110	11944559.110	12184559.110	12427559.110	12673559.110	12922559.110	13174559.110	13429559.110	13687559.110	13948559.110	14212559.110	14479559.110	14749559.110	15022559.110	15298559.110	15577559.110	15859559.110	16144559.110	16432559.110	16723559.110	17017559.110	17314559.110	17614559.110	17917559.110	18223559.110	18532559.110	18844559.110	19159559.110	19477559.110	19798559.110	20122559.110	20449559.110	20779559.110	21112559.110	21448559.110	21787559.110	22129559.110	22474559.110	22822559.110	23173559.110	23527559.110	23884559.110	24244559.110	24607559.110	24973559.110	25342559.110	25714559.110	26089559.110	26467559.110	26848559.110	27232559.110	27619559.110	28009559.110	28402559.110	28798559.110	29197559.110	29599559.110	29994559.110	30392559.110	30793559.110	31197559.110	31604559.110	32014559.110	32427559.110	32843559.110	33262559.110	33684559.110	34109559.110	34537559.110	34968559.110	35402559.110	35839559.110	36279559.110	36722559.110	37168559.110	37617559.110	38069559.110	38524559.110	38982559.110	39443559.110	39907559.110	40374559.110	40844559.110	41317559.110	41793559.110	42272559.110	42754559.110	43239559.110	43727559.110	44218559.110	44712559.110	45209559.110	45709559.110	46212559.110	46718559.110	47227559.110	47739559.110	48254559.110	48772559.110	49293559.110	49817559.110	50344559.110	50874559.110	51407559.110	51943559.110	52482559.110	53024559.110	53569559.110	54117559.110	54668559.110	55222559.110	55779559.110	56339559.110	56902559.110	57468559.110	58037559.110	58609559.110	59184559.110	59762559.110	60343559.110	60927559.110	61514559.110	62104559.110	62697559.110	63293559.110	63892559.110	64494559.110	65099559.110	65707559.110	66318559.110	66932559.110	67549559.110	68169559.110	68792559.110	69418559.110	70047559.110	70679559.110	71314559.110	71952559.110	72593559.110	73237559.110	73884559.110	74534559.110	75187559.110	75843559.110	76502559.110	77164559.110	77829559.110	78497559.110	79168559.110	79842559.110	80519559.110	81199559.110	81882559.110	82568559.110	83257559.110	83949559.110	84644559.110	85342559.110	86043559.110	86747559.110	87454559.110	88164559.110	88877559.110	89593559.110	90312559.110	91034559.110	91759559.110	92487559.110	93218559.110	93952559.110	94689559.110	95429559.110	96172559.110	96918559.110	97667559.110	98419559.110	99174559.110	99932559.110	100693559.110	101457559.110	102224559.110	102994559.110	103767559.110	104543559.110	105322559.110	106104559.110	106889559.110	107677559.110	108468559.110	109262559.110	110059559.110	110857559.110	111658559.110	112462559.110	113269559.110	114079559.110	114892559.110	115708559.110	116527559.110	117349559.110	118174559.110	118992559.110	119813559.110	120637559.110	121464559.110	122294559.110	123127559.110	123963559.110	124802559.110	125644559.110	126489559.110	127337559.110	128188559.110	129042559.110	129899559.110	130759559.110	131622559.110	132488559.110	133357559.110	134229559.110	135104559.110	135982559.110	136863559.110	137747559.110	138634559.110	139524559.110	140417559.110	141313559.110	142212559.110	143114559.110	144019559.110	144927559.110	145838559.110	146752559.110	147669559.110	148589559.110	149512559.110	150438559.110	151367559.110	152299559.110	153234559.110	154172559.110	155113559.110	156057559.110	156994559.110	157934559.110	158877559.110	159823559.110	160772559.110	161724559.110	162679559.110	163637559.110	164598559.110	165562559.110	166529559.110	167499559.110	168472559.110	169448559.110	170427559.110	171409559.110	172394559.110	173382559.110	174373559.110	175367559.110	176364559.110	177364559.110	178367559.110	179373559.110	180382559.110	181394559.110	182408559.110	183425559.110	184445559.110	185468559.110	186494559.110	187523559.110	188555559.110	189589559.110	190626559.110	191666559.110	192709559.110	193755559.110	194803559.110	195854559.110	196907559.110	197963559.110	199022559.110	200084559.110	201149559.110	202217559.110	203288559.110	204362559.110	205439559.110	206519559.110	207602559.110	208688559.110	209777559.110	210869559.110	211964559.110	213062559.110	214163559.110	215267559.110	216374559.110	217484559.110	218597559.110	219713559.110	220832559.110	221954559.110	223079559.110	224207559.110	225338559.110	226472559.110	227609559.110	228749559.110	229892559.110	231038559.110	232187559.110	233339559.110	234494559.110	235652559.110	236813559.110	237977559.110	239144559.110	240314559.110	241487559.110	242663559.110	243842559.110	245024559.110	246209559.110	247397559.110	248588559.110	249782559.110	250979559.110	252179559.110	253382559.110	254588559.110	255797559.110	257009559.110	258224559.110	259442559.110	260663559.110	261887559.110	263114559.110	264344559.110	265577559.110	266813559.110	268052559.110	269294559.110	270539559.110	271787559.110	273038559.110	274292559.110	275549559.110	276809559.110	278072559.110	279338559.110	280607559.110	281879559.110	283154559.110	284432559.110	285713559.110	286997559.110	288284559.110	289574559.110	290867559.110	292163559.110	293462559.110	294764559.110	296069559.110	297377559.110	298688559.110	299992559.110	301299559.110	302609559.110	303922559.110	305238559.110	306557559.110	307879559.110	309204559.110	310532559.110	311863559.110	313197559.110	314534559.110	315874559.110	317217559.110	318563559.110	319912559.110	321264559.110	322619559.110	323977559.110	325338559.110	326702559.110	328069559.110	329439559.110	330812559.110	332188559.110	333567559.110	334949559.110	336334559.110	337722559.110	339113559.110	340507559.110	341904559.110	343304559.110	344707559.110	346113559.110	347522559.110	348934559.110	350349559.110	351767559.110	353188559.110	354612559.110	356039559.110	357469559.110	358902559.110	360338559.110	361777559.110	363219559.110	364664559.110	366112559.110	367563559.110	369017559.110	370474559.110	371934559.110	373397559.110	374863559.110	376332559.110	377804559.110	379279559.110	380757559.110	382238559.110	383722559.110	385209559.110	386699559.110	388192559.110	389688559.110	391187559.110	392689559.110	394194559.110	395702559.110	397213559.110	398727559.110	400244559.110	401764559.110	403287559.110	404813559.110	406342559.110	407874559.110	409409559.110	410947559.110	412488559.110	414032559.110	415579559.110	417129559.110	418682559.110	420238559.110	421797559.110	423359559.110	424924559.110	426492559.110	428063559.110	429637559.110	431214559.110	432794559.110	434377559.110	435963559.110	437552559.110	439144559.110	440739559.110	442337559.110	443938559.110	445542559.110	447149559.110	448759559.110	450372559.110	451988559.110	453607559.110	455229559.110	456854559.110	458482559.110	460113559.110	461747559.110	463384559.110	465024559.110	466667559.110	468313559.110	469962559.110	471614559.110	473269559.110	474927559.110	476588559.110	478252559.110	479919559.110	481589559.110	483262559.110	484938559.110	486617559.110	488300559.110	489986559.110	491675559.110	493367559.110	495062559.110	496760559.110	498461559.110	500165559.110	501872559.110	503582559.110	505295559.110	507011559.110	508730559.110	510452559.110	512177559.110	513905559.110	515636559.110	517370559.110	519107559.110	520847559.110	522590559.110	524336559.110	526085559.110	527837559.110	529592559.110	531350559.110	533111559.110	534875559.110	536642559.110	538413559.110	540187559.110	541964559.110	543744559.110	545527559.110	547313559.110	549103559.110	550896559.110	552692559.110	554491559.110	556293559.110	558098559.110	559906559.110	561717559.110	563531559.110	565348559.110	567168559.110	568991559.110	570817559.110	572646559.110	574478559.110	576313559.110	578151559.110	580002559.110	581856559.110	583713559.110	585573559.110	587436559.110	589302559.110	591171559.110	593043559.110	594918559.110	596796559.110	598677559.110	600561559.110	602448559.110	604338559.110	606231559.110	608127559.110	610026559.110	611928559.110	613833559.110	615741559.110	617652559.110	619566559.110	621483559.110	623403559.110	625326559.110	627252559.110	629181559.110	631113559.110	633048559.110	634986559.110	636927559.110	638871559.110	640818559.110	642768559.110	644721559.110	646677559.110	648636559.110	650598559.110	652563559.110	654531559.110	656502559.
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[illegible]

1520.11	1522.32	1524.53	1526.74	1528.95	1531.16	1533.37	1535.58	1537.79
//1517.89								
//1540.00								

Flow	0.00	84.39	603.70	2273.33	5683.02	11252.24	19471.04	30716.07	45339.13
Flow	0.00	84.39	603.70	2273.33	5683.02	11252.24	19471.04	30716.07	45339.13

86364.10	115021.44	149424.58	187209.00	229227.01	275542.52	326227.59	381360.18	441022.59
505300.30								

505300.30

2/3

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 3

ISTAG	ICOMP	TECON	ITYPE	JPLT	JPRY	INAME	ISTAGE	TAUTO
11	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INVDG	AREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	.57	0.00	.57	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .880

LOSS DATA

LROPI	STHCR	DLTKM	MTIOL	ERAIN	SINKS	HTIOK	SIRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.34 CP= .50 NTA= 0

RECESSION DATA

SIRIO= -1.50 OKCSN= -.05 RTIOK= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE 10= 5.89 AND 1P ARE 7.21 INTERVALS

UNIT HYDROGRAPH 42 END-OF-PERIOD ORDINATES, LA= 1.34 HOURS, CP= .50 VOL= 1.00	
9.	35.
73.	64.
18.	16.
5.	4.
1.	1.
130.	138.
105.	128.
48.	37.
17.	9.
3.	2.
111.	11.
32.	24.
8.	6.
2.	1.
84.	21.
97.	5.

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 3

ISTAO	TCOMP	TECON	ITAPE	JPLY	JPRY	INAME	ISTAGE	IAUTO
13	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME

D-40

ROUTING DATA

QLOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTUL	LAG	AMSK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1895	21

STAGE	1995.00	1995.50	1996.00	1996.50	1997.00	1997.50	1998.00	1998.50	1999.00	1999.50	2000.00
1995.00	1995.00	1995.50	1996.00	1996.50	1997.00	1997.50	1998.00	1998.50	1999.00	1999.50	2000.00

FLOW	0.00	40.00	100.00	190.00	300.00	420.00	550.00	1200.00	3560.00
1995.00	0.00	40.00	100.00	190.00	300.00	420.00	550.00	1200.00	3560.00

SURFACE AREA	0.0	2.0	4.0	6.0
1995.00	0.0	2.0	4.0	6.0

CAPACITY	0.0	33.0	48.0	148.0
1995.00	0.0	33.0	48.0	148.0

ELEVATION	1995.00	1995.50	1996.00	1996.50	1997.00
1995.00	1995.00	1995.50	1996.00	1996.50	1997.00

CREL	SPWID	COGW	EAPW	ELEV	COUL	CAREA	EXPL
1995.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DAM DATA			
TOPEL	COOD	EXPD	DAMWID
1497.6	3.0	1.5	442.0

DAM DETACH DATA			
BRWID	Z	FLRM	TFAIL
0.00	0.50	1466.20	2.00

WSFL	FAILL
1495.00	1497.90

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)

AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION STATION AREA PLAN RATIO 1
 .30

HYDROGRAPH AT 1 .29 1 306.
 .75) 8.67) 1
 2 306.
 (8.67) (

ROUTED TO 2 .29 1 199.
 (.75) (5.64) (199.
 2 199.
 (5.64) (

HYDROGRAPH AT 3 .11 1 116.
 (.28) (3.29) (116.
 2 116.
 (3.29) (

2 COMBINED 4 .40 1 282.
 (.04) 7.99) 1
 2 282.
 (7.99) (

ROUTED TO 5 .40 1 276.
 (1.04) (7.82) (276.
 2 276.
 (7.82) (

ROUTED TO 6 .40 1 276.
 (1.04) (7.82) (276.
 2 276.
 (7.82) (

HYDROGRAPH AT 7 .04 1 53.
 (.10) 1.49) 1
 2 53.
 (1.49) (

ROUTED TO 8 .04 1 46.
 (.10) (1.32) (46.
 2 46.
 (1.32) (

2 COMBINED 9 .44 1 305.
 (1.14) (8.63) (305.
 2 305.
 (8.63) (

ROUTED TO 10 .44 1 305.
 (1.14) 8.63) 1
 2 305.
 (8.63) (

4/9

2 305.
(8.6311

HYDROGRAPH AT 11 1.57 1 484.
(1.481 (13.7211

2 484.
(13.7211

2 COMBINED 12 1.01 1 769.
(2.621 (21.7811

2 769.
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ROUTED TO 13 1.01 1 1192.
(2.621 (33.7411

2 769.
(21.7811

ROUTED TO 14 1.01 1 1235.
(2.621 (35.0711

2 769.
(21.7611

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1									
ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM			
1675.00		1675.00		1675.00		1678.50			
72		72		72		730			
0		0		0					
STORAGE		MAXIMUM STORAGE		MAXIMUM OUTFLOW		DURATION OVER TOP		TIME OF MAX OUTFLOW	
OUTFLOW		AC-FT		CS		HOURS		HOURS	
		77		199		0.00		42.00	
								0.00	
RATIO OF		MAXIMUM DEPTH		MAXIMUM STORAGE		MAXIMUM OUTFLOW		TIME OF FAILURE	
W.5-LEVEL		OVER DAM		AC-FT		CS		HOURS	
1676.63		0.00		77		199		0.00	
830									

PLAN 2	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	
	STORAGE	1675.00	1675.00	1678.50	
	OUTFLOW	42.	42.	143.	
		0.	0.	730.	

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FATIGUE HOURS
30	1676.45	0.00	77.	199.	0.00	42.00	0.00

D-43

12/19

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1									
ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM			
STORAGE		1660.00		1660.00		1663.10			
OUTFLOW		54		0.		82.		766.	
MAXIMUM		MAXIMUM		MAXIMUM		MAXIMUM		MAXIMUM	
RESERVOIR		STORAGE		OUTFLOW		OVER TOP		MAX OUTFLOW	
W.S.ELEV		AC-FT		CFS		HOURS		HOURS	
TIME OF		DURATION		OVER TOP		HOURS		FAILURE	
PHF		OVER DAM		AC-FT		HOURS		HOURS	
0.30		0.00		68.		276.		41.75	
1661.66		0.00		0.00		0.00		0.00	

PLAN 2									
ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM			
STORAGE		1660.00		1660.00		1663.10			
OUTFLOW		54.		0.		82.		766.	
MAXIMUM		MAXIMUM		MAXIMUM		MAXIMUM		MAXIMUM	
RESERVOIR		STORAGE		OUTFLOW		OVER TOP		MAX OUTFLOW	
W.S.ELEV		AC-FT		CFS		HOURS		HOURS	
TIME OF		DURATION		OVER TOP		HOURS		FAILURE	
PHF		OVER DAM		AC-FT		HOURS		HOURS	
0.30		0.00		68.		276.		41.75	
1661.66		0.00		0.00		0.00		0.00	

D-4

PLAN 1									
RATIO		MAXIMUM		MAXIMUM		MAXIMUM		MAXIMUM	
FLOW		CFS		STAGE		FT		TIME	
HOURS		HOURS		HOURS		HOURS		HOURS	
0.30		276.		1620.9		42.00			

PLAN 2									
RATIO		MAXIMUM		MAXIMUM		MAXIMUM		MAXIMUM	
FLOW		CFS		STAGE		FT		TIME	
HOURS		HOURS		HOURS		HOURS		HOURS	
0.30		276.		1620.9		42.00			

19/2

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1									
RATIO OF PMF	MAXIMUM RESERVOIR ELEVATION W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TOP OF DAM			
						SPILLWAY CREST		TIME OF	
						INITIAL VALUE	1643.00	MAX OUTFLOW	FAILURE
.30	1644.27	0.00	14.	46.	0.00	1646.00	12.	40.50	0.00
							0.		
							17.		
							180.		

PLAN 2									
RATIO OF PMF	MAXIMUM RESERVOIR ELEVATION W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TOP OF DAM			
						INITIAL VALUE	1643.00	MAX OUTFLOW	FAILURE
						1646.00	12.	40.50	0.00
.30	1644.27	0.00	14.	46.	0.00		0.		
							17.		
							180.		

D-46

PLAN 1 STATION 10									
RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS						
.30	305.	1501.1	41.75						

PLAN 2 STATION 10									
RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS						
.30	305.	1501.1	41.75						

17/9

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1									
ELEVATION		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM					
STORAGE		1495.00	1495.00	1497.60					
OUTFLOW		33	33	40					
		0	0	446					
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS		
		0.31	41	1227	1.08	41.38	41.00		
0.30	1497.91								

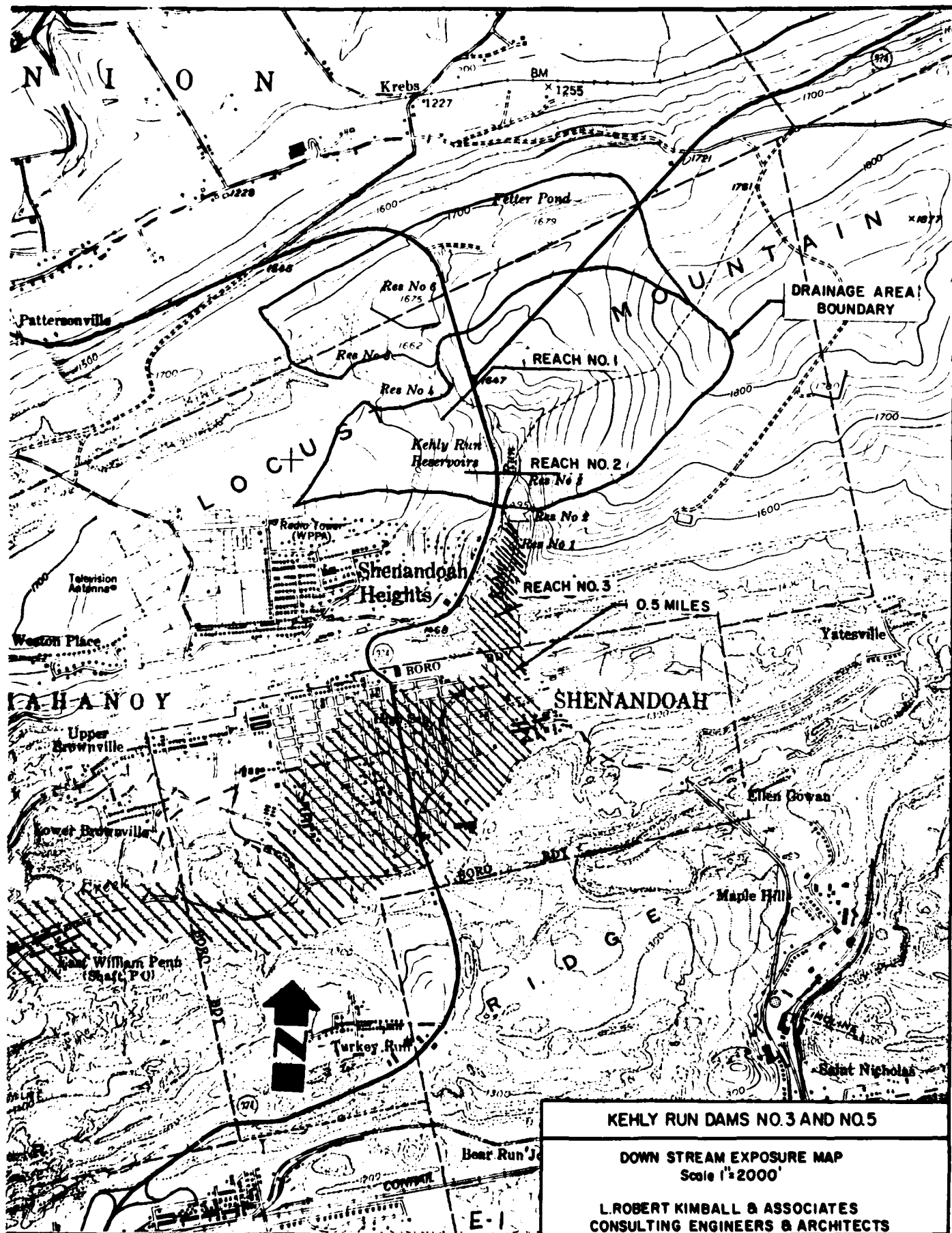
PLAN 2									
ELEVATION		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM					
STORAGE		1495.00	1495.00	1497.60					
OUTFLOW		33	33	40					
		0	0	446					
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS		
		0.32	41	769	3.50	41.25	0.00		
0.30	1497.92								

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PLAN 1 STATION 14			
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	1238.	1384.6	41.50

PLAN 2 STATION 14			
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	759.	1383.6	41.25

APPENDIX E
DRAWINGS



KEELY RUN DAMS NO. 3 AND NO. 5

DOWN STREAM EXPOSURE MAP
Scale 1"=2000'

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

APPENDIX F
GEOLOGY

AD-A083 747

KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA
NATIONAL DAM INSPECTION PROGRAM, KEHLY RUN DAM
MAR 80 R J KIMBALL

F/6 13/13
NUMBER 3 (NDS ID--ETC(U)
DACW31-80-C-0020

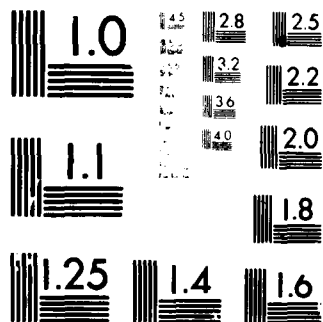
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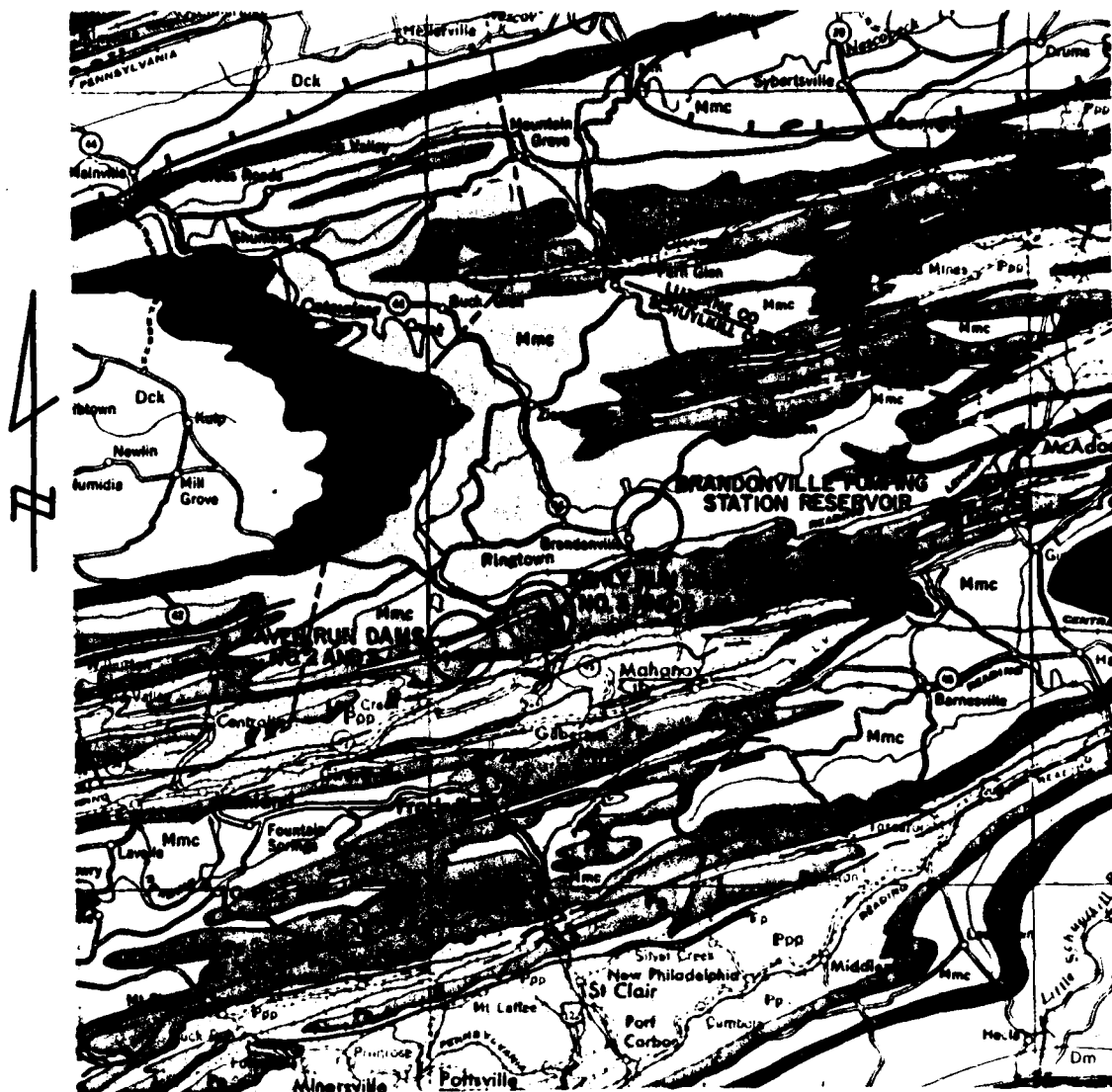


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Kehly Run Dam No. 3 - General Geology

Kehly Run Dam No. 3 is located in the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. This province is typified by numerous synclinal and anticlinal features. Some minor faulting is indicated to the south of the reservoir. The bedrock underlying the dam consists of the Pennsylvanian aged Pottsville Group. This unit consists of light to dark gray, fine grained to conglomeratic sandstone, with lesser amounts of shale, siltstone, limestone, coal and underclay. The bedding is generally well developed with the sandstones and siltstones often cross-bedded. Joints are usually regular and moderately well formed.

Both deep mining and surface mining of anthracite coal have taken place in the vicinity of this dam. The extent of any deep mining is unknown without extensive research.



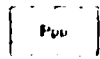
**GEOLOGIC MAP OF THE AREA SURROUNDING
RAVEN RUN DAMS NO. 2 AND 3,
KEHLY RUN DAMS NO. 3 AND 5,
BRANDONVILLE PUMPING STATION RESERVOIR**



Pottsville Group

Predominantly sandstones and conglomerates with thin shales and coals, some with mineable locally

ANTHRACITE REGION



Post-Pottsville Formations

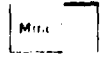
Brachiopod, graptolite and stromatolite fossils with some conglomerate and numerous mineable coals



Pottsville Group

Light gray to white, coarse grained sandstone and conglomerates with thin shales and coals. Some with mineable locally. See also Schuylkill and Tumbler Formations

MISSISSIPPIAN



Mauch Chunk Formation

Reddish brown to black, fine grained sandstone and siltstone with thin shales and coals. Some with mineable locally. See also Schuylkill and Tumbler Formations

